No. 2641 VOLUME 76 FRIDAY 23 OCTOBER 1959

FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

Official Organ of the Royal Aero Club First Aeronautical Weekly in the World Founded 1909

Editor-in-Chief
MAURICE A. SMITH D.F.C.

Editor
H. F. KING M.B.E.

Technical Editor
W. T. GUNSTON

Production Editor
ROY CASEY

IN THIS ISSUE

From All Quarters 420
Missiles and Spaceflight 423
Aeronautical Bookshelf 427
Aid to Otopia 428
Bloodhound 431
Straight and Level 438
Sport and Business 439
The Industry 440
Correspondence 441
Air Commerce 443
Service Aviation 448

Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1; telephone Waterloo 3333. Telegrams Flightpres Sedist London. Annual subscriptions: Home £4 15s, Overseas £5. Canada and U.S.A. $15.00. Second Class Mail privileges authorized at New York, N.Y.

Branch Offices Coventry: 8-10 Corporation Street; telephone Coventry 25210. Birmingham: King Edward House, New Street, 2; telephone Midland 7191. Manchester: 260 Deansgate, 3; telephone Blackfriars 4412 or Deansgate 3595. Glasgow: 26B Renfield Street, C.2; telephone Central 1265. New York, N.Y.: Thomas Skinner & Co. (Publishers) Ltd., 111 Broadway, 6; telephone Digby 9-1197.

© Iliffe & Sons Ltd., 1959. Permission to reproduce illustrations and letterpress can be granted only under written agreement. Brief extracts or comments may be made with due acknowledgement.

Cabinet Rank

A YEAR or so ago a British aircraft firm (it was Hunting, but that is incidental) inadvertently described one of its aircraft as having been built "under contract to the Ministry of Supply and Civil Aviation." This should, of course, have read Ministry of *Transport* and Civil Aviation. Our columnist Roger Bacon wondered at the time whether this was a sign that the industry, for a change, was attempting to rationalize the Government.

It so happens that the composite Ministry thus erroneously described defines quite well the new Ministry of Aviation. One Minister will henceforth guide the destinies of both the aircraft industry and the airline operating industry. For the first time aviation in its own right attains Cabinet rank. It is up there at the top, where it should be, alongside the other prime portfolios of British administration.

The creation of this new Ministry, which will embrace the functions of the Civil Aviation Department of the old Transport Ministry as well as those of the now extinct Supply Ministry, was the one really major change made by the Prime Minister in his new Government. And over all Mr. Macmillan has placed a man of exceptional determination and vigour, whose progressive measures as Defence Minister blew a chill wind through the industry for which he is now responsible.

Policies and Projects

Mr. Duncan Sandys will receive a good deal of advice from the industry itself, and from outside, while he takes stock. That he should, for example, reverse the "pay for your own civil development" policy of Mr. Aubrey Jones. That our supersonic airliner (and other projects) should be European, rather than insular ventures. That expansionist air transport policies are the "grass roots" of a healthy aircraft industry. And that the destinies of the twain—now at last under one Minister—are indivisible.

Much indeed depends on the skill with which our air transport industry is regulated. What is needed above all is an authority—call it an Air Transport Board or what you will—which gathers into one compact executive the several tasks of economic and operational regulation, negotiation of foreign air traffic rights, licensing of operators, personnel and equipment, and collection of statistical data. This can be done without allowing the dead hand of bureaucracy to overgovern and interfere. Let the new Minister retain those essentially British qualities of the Air Transport Advisory Council, whereby a handful of men of goodwill and good humour settle conflicts around a table. But, in an expanding industry, these qualities are of little avail if there is no analytical staff-work to support them. "Judgment" and "experience" are no substitutes for an independent expert assessment of the issues involved—very big issues, some of them; for example, that discussed on pages 444 and 445 of this issue.

If the new Minister wants to know how to reconcile the interests of public and private ownership in air transport, let him go and talk to the French, or better still to the Australians and the Canadians. And while he is looking at the enlightened mixed-economy policies of these two Commonwealth countries (which have certainly made us look rather old-fashioned) let him be inspired to foster the pan-Commonwealth airline idea that is now ripening.

BOUND SOUTH OF CANBERRA: The Acting High Commissioner for New Zealand, Mr. G. R. Laking, is seen at Upwood bidding farewell to R.N.Z.A.F. aircrew making a delivery flight of Canberras to New Zealand. Left to right: F/L. A. R. Campbell, Mr. Laking, S/L. H. Moss, F/O. R. F. Lawry, A. Cdre. I. G. Morrison (A.O.C., R.N.Z.A.F. headquarters in London), and F/L. M. D. Peacock

FROM ALL QUARTERS

Minister of Aviation

HAVING been given charge of the new Aviation Ministry under Mr. Macmillan's Governmental changes, Mr. Duncan Sandys lost no time in arranging to meet the principal representatives of the aircraft industry and air transport to ascertain their views on the problems involved. He also firmly delineated the division of responsibility between himself and his successor as Minister of Defence, Mr. Harold Watkinson. The latter's responsibilities, he said, were clearly defined in the White Paper approved by Parliament last year. The greater part of the equipment programme for the three Services was "well under way," and the Ministry of Aviation would be responsible for carrying through the part which came within its sphere. Mr. Sandys added that the strengthening of the aircraft industry and expansion of air services would be "much facilitated by the Prime Minister's decision to give a single minister responsibility for both aircraft production and civil aviation." Mr. Sandys' new post—the creation of which has been welcomed by the S.B.A.C.—covers the aviation and missile research functions of the Ministry of Supply, which has been abolished. Mr. Sandys was Minister of Supply from 1951 to 1954 and two of his wartime posts were chairman of the War Cabinet Committee for defence against German "V" weapons (1943-45) and Parliamentary Secretary, Ministry of Supply (1943-44).

Mr. Duncan Sandys

Mr. George Ward remains Secretary of State for Air but his Parliamentary Under-Secretary is now Mr. W. J. Taylor, Mr. Airey Neave having left the Government at his own request.

Cranfield Symposium

THE Cockerell Hovercraft, supersonic transport aircraft and satellites and space travel were among the subjects discussed at a private symposium at the College of Aeronautics last week-end. Organized by the Cranfield Society, the association of former students of the College, the meeting had as its general theme "Future Developments in Aviation."

Ex-students who presented papers at the meeting included Mr. Richard Stanton-Jones, chief designer of Saunders-Roe Ltd., who described the design, development and construction of the Hovercraft, and Mr. George Henson, an assistant chief designer of Vickers-Armstrongs (Aircraft) Ltd., who spoke on military aircraft. Future rotorcraft were discussed by Dr. G. S. Hislop of Fairey Aviation Ltd., supersonic civil transport aircraft by Mr. R. G. Thorne of R.A.E. Farnborough, satellites and space travel by Mr. T. R. F. Nonweiler of Queen's University, Belfast, and the contribution of the College of Aeronautics by Prof. A. J. Murphy, the college principal. Attendance at the meeting, the first of its kind held by the Society, was approximately 200.

Big-jet Disasters

SECOND Boeing 707 to be written off, a 707-227 due to be delivered to Braniff International Airways, crashed last Monday near Arlington, Wash, in the Cascade foothills. Boeing said four men escaped and four were killed, suggesting that at least one Braniff crew was on board.

On October 15 a B-52 and KC-135 of S.A.C. exploded in the air during a night refuelling. Eight of the twelve men aboard were killed. Wreckage was strewn over a wide area of Kentucky and in it were found the bomber's two nuclear weapons.

The Pegasus Proposal

REFERRING to our news-item "Aircraft for the Army" (October 2), Scottish Aviation Ltd. say that their original proposal was "a variant of the Pioneer" with a long-stroke Alvis Leonides, employing the same wings and tail assembly but with a new high-capacity fuselage. However, this has been superseded by the Pegasus proposal, an entirely new design bearing no relationship to the Pioneer. In its basic form, as offered to the Army, the Pegasus would be powered by a Type 514/8 Leonides as installed in the Twin Pioneer. Scottish Aviation add that "the design has considerable development potential, both for military and civil rôles. Such development might make use of the 531 engine."

CHAIN LIGHTNING: The second English Electric Lightning T.4, bearing the Service number XL629, is here seen carrying two 30 mm Aden guns beneath the air intake. (The first specimen was armed with two D.H. Propellers Firestreak missiles in place of the guns)

RENEWING ASSOCIATIONS with Greece (as reported on page 448) is No. 33 Squadron. Four of the squadron's Gloster Javelins are seen. No. 33 was based in Greece between February and April 1941, its main task being the escort of Blenheims on daylight raids with its Hurricanes

Anglo-American A.T.C.

IT is apparent that the vast American plan for air traffic control—now being developed by the Federal Aviation Agency's Bureau of Research and Development at Atlantic City—aims mainly at solving U.S. internal problems. The obvious implication is that the new system, which was described in *Flight* for February 20 and is to mature in 1963, might have to be accepted internationally because even then it would probably still be the most advanced available. It would thus prove to be one more American system developed to meet a purely national need but adopted for international use. (The preponderance of American developments in the international field was further discussed in *Flight* for October 9.)

As recorded last week, a team of M.T.C.A., Air Ministry and M.o.S. experts has been in Washington discussing with the F.A.A. traffic control, navigation systems and related topics. It appears that the aim of the discussions was the establishment of closer liaison between the two countries, and practical co-operation and exchange of views now seems certain. Early in the new year a British team of three or four officers—probably of deputy director status and specializing in telecommunications, air traffic control, operations and related scientific subjects—will go to America to work in close co-operation with the F.A.A. An analogous American team is likely to come to England to work with the new Ministry of Aviation.

Elliott White Springs

REPORTED from New York is the death of Elliott White Springs, on October 15, at the age of 63. He was credited with eleven victories over German aircraft during the First World War; he first served with the Royal Flying Corps. Elliott White Springs is especially remembered for his book *War Birds: Diary of an Unknown Aviator*, which is now regarded as an aeronautical classic. He is also known, in America at least, for the advertising copy he turned out for the products of his own textile mills.

Cranwell Entry Changes

ACADEMIC standards for entry to the R.A.F. College, Cranwell, are to be raised from September 1961. Qualification by the Navy, Army and Air Force entrance examination set by the Civil Service Commissioners is being discontinued. Instead, candidates will be required to have passes at advanced level in at least two subjects of the G.C.E., plus "an acceptable pattern" of subjects at ordinary level, or recognized equivalent qualifications. There is also to be a broadening of the Cranwell academic syllabus.

More Power to Their Elbows

THE inaugural meeting of the Man-Powered Aircraft Group of the Royal Aeronautical Society is to be held next Friday, October 30, with the president of the Society, Mr. P. G. Masefield, in the chair. The meeting will take the form of a resumé of the theory and practice of flight by man-power, with a number of members of the new group available to initiate discussion and answer questions.

Mr. H. B. Irving, chairman of the group's steering committee, will open proceedings with a brief historical survey, and the other members on the platform will be Dr. D. R. Wilkie of University College, London, an expert on human muscular mechanisms; Mr. T. R. F. Nonweiler, a senior lecturer in aeronautical engineering at Queen's University, Belfast, who has recently completed a design study for a two-man-powered aircraft; Mr. B. S. Shenstone, chief engineer of B.E.A., who has for many years interested himself in the engineering problems of flight by man-power; and Mr. J. L. Nayler, secretary of the A.R.C. from 1920-1956 and of the Commonwealth Advisory Research Council from 1946 to 1956, who will speak on the subject of bird flight.

The meeting will be held in the library at 4 Hamilton Place, London, W.1, and visitors' tickets are obtainable on application to the secretary of the R.Ae.S. at that address.

Independent Air Travel Shut-Down

THE affairs of Independent Air Travel Ltd. have been placed in the hands of a receiver and manager by Lombard Bank, the airline's sole debenture holders. He is Mr. Arthur Bass, a chartered accountant who was appointed one of three directors of Blue Air Ltd., in April this year. The staff of over 150, including pilots and cabin crew, have been given notice of dismissal. In spite of repayments to creditors of £60,000 to £70,000 made during the summer months—"an immense strain on our resources"—liabilities are estimated at over £100,000, much of it for the supply of fuel. The company is unable to continue operating on the reduced business of winter months.

Speaking of financial liabilities, Mr. A. E. Cooper, the chairman of I.A.T. appointed by the Bank after the Viking accident at Southall, said last weekend: "It was an odds-on chance from the word go . . . some of the debts we found were two or three years old. When the company was reorganized after the crash the liabilities were enormous." That, coupled with the withdrawal of licences, the Viking accident inquiry report (see *Flight*, August 21 and August 28, 1959) and adverse publicity, had made the position "quite impossible." Mr. Cooper added that "the final straw was that the insurance company would not pay the £26,000 for which the crashed Viking was insured."

Independent's principal assets are its four Vikings and supporting equipment; hire-purchase payments on four DC-4s have recently been taken over by Blue Air, the company whose name was purchased about six months ago by Mr. Cooper, by Capt. T. Langton, managing director of Universal Sky Tours, and by A. Cdre. Sydney Smith, Deputy Lieutenant of Yorkshire. "The intention," said Mr. Cooper, "was to transfer everything from Independent to Blue Air, but because of licences which were not granted, neither the liability nor the assets of Independent were transferred."

QUEEN AIR is the name chosen for the new Beechcraft Model 65, "unveiled" in Minneapolis this month (but first illustrated in "Flight" of August 28). Powered by two 340 h.p. Lycomings, the aircraft seats up to seven persons and has a gross weight of 7,700 lb

STEPPING OUT: A zero-length-launched F-100 Super Sabre takes its exit from a simulated atomic shelter during tests at Holloman Air Force Base, New Mexico

MOLLUSCOID INSPECTION: Sir Charles Lambe (centre), First Sea Lord and Chief of Naval Staff, is seen during his recent visit to the Coventry factories of Sir W. G. Armstrong Whitworth Aircraft Ltd. when he inspected Seaslug production. With him are (l. to r.) Mr. C. Bayly, director and chief engineer, A.W.A. Armaments Division; Sir William Farren, director of Hawker Siddeley Aviation Ltd.; and Mr. A. H. Pope, production manager, Armaments Division

FROM ALL QUARTERS . . .

TRAILING AERIAL: The Bristol 192 (two Napier Gazelle) did its first commercial job near Cambridge recently. The load, seen here, is a parabolic aerial for a radio telescope. It weighs two tons and was moved to a new site at the Mullard Radio Astronomy Laboratory. A cross-country journey of six miles was made and the whole operation was completed in five minutes

IN BRIEF

Lockheed Aircraft Corporation still hope to negotiate licens agreements for the manufacture of the C-130 Hercules in Europe.

The U.S. Air Force UCX specification for a utility transport and cr trainer has been won by the Lockheed Jetstar.

Aero Service Corporation, the air survey company, are mov their European offices from London to Madrid (Avenida Ameri 2-11°B) on November 9.

Three crop-spraying helicopters are to participate in this ye (November 14) Lord Mayor's Show, which has an agricultural them They will spray the Thames with coloured water to demonstrate ho their operations are carried out. A Fison-Airwork Hiller, Crop Culto Djinn and Helicopter Services' Bell are scheduled to appear.

Since 1950 the U.S.A.F. has lost 3,471 pilots and 7,062 aircraft accidents. Giving these figures last week, the Deputy Inspect General for Safety of the Air Force, Maj-Gen. Caldara, said that tw thirds of the accidents "should never have happened."

Fairey Air Surveys Ltd. have been awarded a contract by the Cro Agents for Overseas Governments and Administration for the aer photography of an area of 17,200 square miles in Eastern Uganda, the region of Lake Victoria. The contract will be supervised by t Directorate of Overseas Surveys and the company plan to use a pho graphic survey DC-3 flying at 24,000ft.

Already established as the leading European manufacturer of gener purpose analogue computers, Short Brothers & Harland are "about market" an entirely new computer which should meet the demand a large general-purpose installation capable of extremely high accura and incorporating fully automatic selection. It is described as "the m advanced of its kind in the world."

Donations amounting to £11,500 have so far been received by Royal Aeronautical Society in response to its appeal for funds to bu a lecture theatre, work on which started at the beginning of th month. Covenants and promises received will bring the total to about £90,000, spread over the next seven to ten years; but ev though the successful tender is less than originally estimated substantial further sum is still required to complete the project.

More than 650 helicopters have now been ordered from Sud Aviat Sales and after-sales departments have been formed, the latter wit statistical department to analyse operating reports from every custom The Djinn III, Alouette III and Frelon are under development and S are now turning their attention to a crane helicopter for NATO and "flying platforms and flying jeeps." The company is also studyi all-weather operation, autopilots and remote control and "all proces that might increase profits while simplifying maintenance."

The Collier Trophy, awarded annually for "the greatest Ameri aviation achievement with value thoroughly demonstrated in ope tion," has been won by the Lockheed F-104 Starfighter. Five recipients are Mr. C. L. Johnson, designer of the airframe; Mr. W Burgess and Mr. Gerhard Neumann, responsible for the develop of the J79 engine; and Lt-Col. Howard Johnson and Maj. W Irwin, the pilots who set up world altitude (91,243ft) and sp (1,404.09 m.p.h.) records in the F-104 last year. The trophy sponsored by the National Aeronautic Association and *Look* magaz

Today's (October 23) issue of our associate journal *The Autocar* the second of its special numbers—Show Report—on the Motor Sh at Earl's Court. Next week a Show Review is being published.

MANPOWER PROBLEM: At a recent Prague kite-flying contest gentleman put in an appearance with his home-made ornithop attachment. Although he never succeeded in getting airborne, he evidently a rousing success in the role of Pied Piper

Missiles and Spaceflight

Preparing for Man in Space—(1) in the Soviet Union: "20 Soviet youths and many dogs" are now in training for manned spaceflight, according to recent articles in Russian magazines. Three of the potential astronauts were named; they are Alexei Blokonev, Ivan Kachur, and Alexei Grachev, who is seen (above right) in a high-altitude chamber. Above left, space dogs Gypsy (fully clad for high-altitude flight) and Matilda (without helmet)

EXPLORER 7 IN ORBIT

Launched successfully by means of a four-stage Juno 2 rocket from Cape Canaveral on Tuesday, October 13, the 91½-lb radiation satellite designated Explorer 7 is expected to remain in orbit for at least one year. Scheduled apogee and perigee were 710 and 330 miles, inclination angle 50 deg, and a variety of scientific instruments was carried. The firing, a joint NASA/ABMA project, was described as the last U.S. satellite launching connected with the International Geophysical Year (which officially ended on December 31, 1958).

Explorer 7 appears to have been comparable in payload instrumentation to the unsuccessful Explorer satellite which was destroyed after lift-off on July 16 following failure of the power supply to the guidance system. The seven main experiments were the measurement of the Earth's radiation and heat balance, Lyman-Alpha and X-rays, heavy primary cosmic rays, micrometeorites, cosmic rays and satellite temperatures, and an erosion study of an exposed solar (silicon) cell on the outer skin of the satellite.

Two radio transmitters are carried, one operating on 20 Mc/s on solar energy and the other on 108 Mc/s on chemical batteries. The batteries are expected to last for two months, and the solar cells will be switched off automatically after one year by means of an electronic timer (by Bulova Watch Co.) carried in the satellite. The cosmic-ray detector was designed by Dr. James Van Allen.

Unofficial names reported to have been bestowed on Explorer 7 included "Kitchen Sink" (referring to the variety of experiments) and "Gyroscope" (the satellite was designed to spin inside its nosecone container after launch and so provide stability in flight).

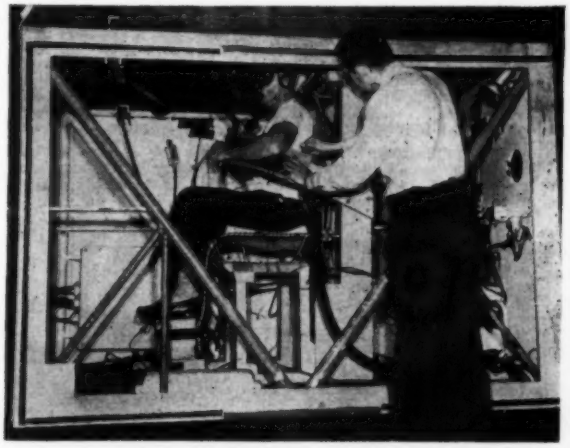
PIONEER 4 REACHES APHELION

At a distance of 107,951,000 miles from the Sun, the U.S. space probe Pioneer 4 passed through the first aphelion (farthest distance from the Sun) of its orbit round the Sun at 1 a.m. G.M.T. on October 9. Speed at aphelion was stated by the NASA Jet Propulsion Laboratory to be 59,848 m.p.h. with respect to the Sun.

Other revised details of the orbit of Pioneer 4, which was launched on March 3, 1959, were quoted as: orbital period, 406.95 days; perihelion (closest point to Sun), 91,720,000 miles on March 18, 1959; speed at perihelion, 70,440 m.p.h.; average speed in orbit, 65,144 m.p.h. (both with respect to the Sun); distance inside average Earth orbit at perihelion, 1,236,000 miles; distance outside average Earth orbit at aphelion, 14,995,000 miles.

SATELLITE TRANSFERS

Transferred from the U.S. Advanced Research Projects Agency following the recent re-shuffle of American military space activity were Midas, an infra-red early-warning satellite for ballistic missile defence, to the Air Force; Samos, the reconnaissance satellite



Preparing for Man in Space—(2) in the United States: Four of the seven Project Mercury astronauts (subject of a feature article on pages 425-6) seen during early physical tests at Wright Air Development Center, Ohio. Below, left to right: Virgil Grissom rides the two-axis equilibrium chair, attended by Dr. Joseph Mundie; Malcolm Carpenter treads the treadmill, whose platform is elevated 2 deg/min until the subject's heartbeat reaches 180/min (in attendance, Dr. Edward B. Weiss); and Donald Slayton prepares for some 65,000ft of simulated altitude in the pressure chamber, assisted by Dr. Charles L. Wilson. Right, John Glenn prepares to ride the Wright centrifuge; conducting the test is Dr. Evan Linberg

Missiles and Spaceflight . . .

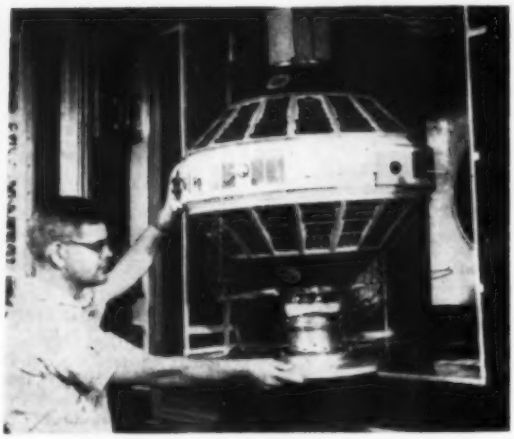
system formerly known as Sentry, to the Air Force; Transit, navigation satellite system, to the Navy; and Notus, a family of communications satellites, to the Army. All are in the development stage.

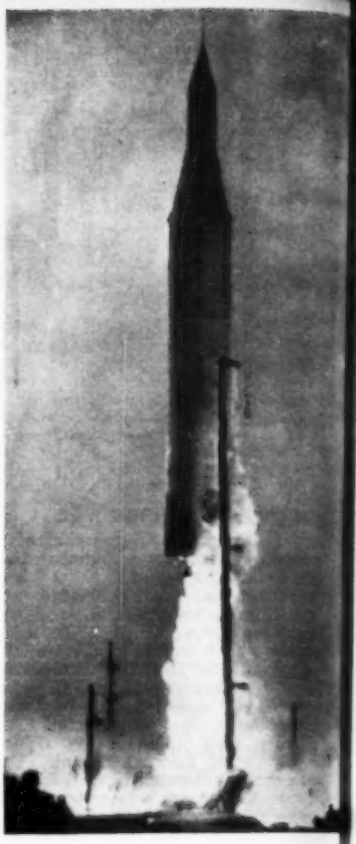
LUNIK 3 RESULTS

The Soviet "automatic interplanetary station" launched on October 4, which was reported to have completed its first orbit around the Earth on Sunday last, October 18, was said to have been successful in obtaining photographs of the distant side of the Moon. According to a Tass announcement on October 18, "the results of the scientific measurements and photographs are being processed and will be published after processing."

The time of the probe's closest approach to Earth was given as 5.20 p.m. G.M.T. on October 18, and the estimated distance from the Earth's centre approximately 29,700 miles.

Writing in *Pravda*, Academician A. Mihailov, director of the Pulkova observatory, Leningrad, suggested that the probe would be influenced by the Moon's gravitational force on subsequent 15-day orbits and might eventually either hit the Moon or re-enter the Earth's atmosphere and burn up. Since the launching of the probe, he said, it had transmitted to Earth by radio "a tremendous amount of invaluable and unique information on the physical properties of the atmosphere surrounding the Earth and Moon and also about the Moon itself."



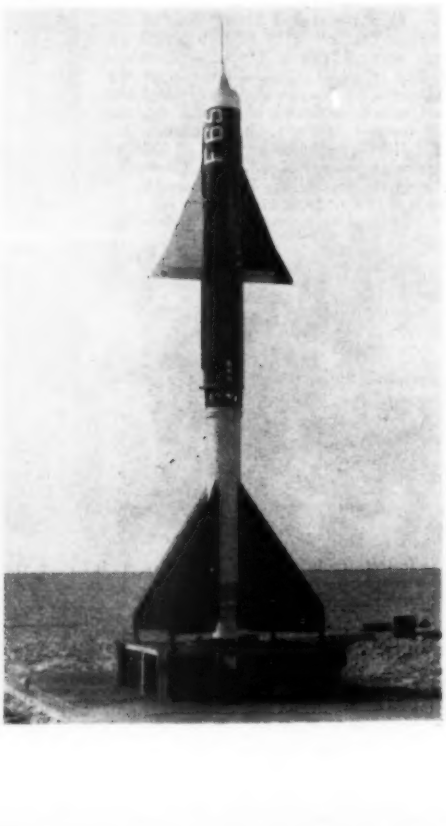


The launching of Explorer 7, reported on the previous page and illustrated on the right, was by Juno 2 rocket. Above, a technician in the ABMA guidance and control laboratory prepares the satellite payload for a temperature/vacuum calibration test prior to launch

An altitude of 60,000ft and a speed of over 1,400 m.p.h. were achieved by Scott Crossfield in the second powered flight of the X-15 research aircraft on October 17. Released from beneath the wing of its parent B-52 at 41,000ft, the X-15 exhausted its fuel in a four-minute burst, and landed at Edwards, California, ten minutes after release.

Speaking in the United Nations General Assembly on October 6, the Soviet deputy foreign minister, Mr. Vasily Kuznetsov, said that Russia proposed to convene under U.N. auspices "an international conference of scientists on the exchange of experience in exploring outer space."

After two failures (*Flight*, October 9, page 348) the U.S. Air Force have apparently succeeded in their attempt to fire a ballistic vehicle from an aircraft and place it in the proximity of a satellite in orbit. The missile, a Bold Orion (Martin's unsuccessful contender for the GAM-87 contract), was launched on October 13 from beneath the wing of a B-47 over Cape Canaveral. The Bold Orion was aimed to achieve the orbit of Explorer 6 ten miles ahead of the satellite in order to provide data leading to the improvement of missile guidance systems. The U.S.A.F. gave no details of the degree of success achieved.



Two new French surface-to-air missiles, both in the flight-test stage. The Nord 5301 (left), data for which were published on October 9 (p. 349), has a two-stage solid motor with jet-deflection, and is essentially a scaled-up Nord 5103. The S.E.4400 (right) has an integral ramjet body and achieves a speed in excess of M 3. Like the less-ambitious Nord weapon it is currently being fired at Colomb-Bechar, in the Sahara

Missiles and Spaceflight . . .

SPACEMEN-ELECT

Astronauts Talk about Project Mercury

MALCOLM CARPENTER
"Navigation is generally detection and correction of errors. In our case we don't have the capability of correcting"

LEROY COOPER
"I think that we are satisfied that we are moving along satisfactorily. Everybody would like to see us progress faster, naturally"

JOHN GLENN
"Certainly the majority of us will ride the Redstone. . . . We are not going to put a man up there in a can just hoping to get him back"

THE U.S. man-in-space programme was discussed by the men most directly concerned—one of whom will in fact be the first American in space—at a press conference last month at the headquarters of the U.S. Air Force Ballistic Missile Division in Los Angeles. This article is based on verbatim extracts from the conference, at which six of the seven Project Mercury astronauts were present.

Capt. Donald K. Slayton, U.S.A.F., having "picked up a slight virus," was absent from the conference. The remaining astronauts are Lt. Malcolm S. Carpenter, U.S.N.; Capt. Leroy G. Cooper, U.S.A.F.; Lt-Col. John H. Glenn, U.S. Marines; Capt. Virgil I. Grissom, U.S.A.F.; Lt-Cdr. Walter M. Schirra, U.S.N.; and Lt-Cdr. Alan B. Shepard, U.S.N. Accompanying the astronauts was Col. John Powers of the NASA Space Task Group, and the rôle of the Ballistic Missile Division in Project Mercury was first outlined by the commander of the Division, Maj-Gen. Osmond J. Ritland.

VIRGIL "GUS" GRISSOM
"If the speed isn't right, the retro-rockets can be fired to bring us back in"

WALTER SCHIRRA
"The impact g is on the order of about 18-20g; somewhere in there"

RITLAND: We in the Air Force Ballistic Missile Division have a certain responsibility in Project Mercury. The Division, with its contractors and the local complex, including Space Technology Laboratories, has the responsibility for launching the Project Mercury capsule, guiding it into orbit, developing an abort system, and the participation in the communications and tracking later on in the programme.

I would like to know if there will be any sub-orbital Atlas operations as well as Redstone.

GLENN: No, none of those are scheduled at the present time. To my knowledge there is no plan at all to make any sub-orbital flights with anything except the Redstones.

Will a man who makes the Redstone flight carry right on through, or will all of you gentlemen make Redstone flights until you get to the final portion of the programme?

GLENN: This is not a real definite laid-out programme yet, as far as that part of it goes. The way the first Redstone flights progress, the unmanned and then the animal shots, will determine of course how many of the Redstones we have to use in the programme, with of course a limited number of Redstones in the whole programme. Certainly the majority of us will ride the Redstone, I am sure. But there is no certainty that that man who rides the first Redstone will also be the one who carries on into the Atlas at all. There is no progression there set up now.

[As part of the astronauts' participation in the project development programme, each of the seven men has been assigned to a particular system or aspect of the Mercury vehicle. These were next detailed by the astronauts.]

SHEPARD: The areas with which I am concerned are the recovery of the capsule after landing, and the worldwide range of tracking stations. In the first case, of course, the capsule is programmed to land in the water in the vicinity of the Atlantic Missile Range. The monitoring of recovery efforts is one of my considerations. The second, as you well realize, as this capsule goes in orbit around the world, we want to keep in as close contact with it as possible. Not only voice communication but also telemetering and finite tracking.

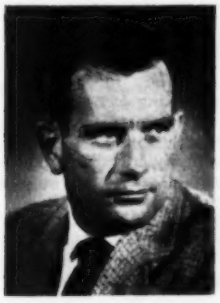
SCHIRRA: I am concerned with the environmental control system. Another way of putting it would be the life support system within the capsule while the capsule is in orbit. This involves maintaining an atmosphere which is approximately equivalent to 27,000ft around our normal atmosphere in the Earth area. This will be maintained in the cabin itself and will be backed up by a full pressure suit that the astronaut will wear while in orbit.

The full pressure suit has a requirement for ventilation which will be part of its normal mission. The full pressure suit as a pressure suit alone is a back-up in case there is something wrong with the cabin system. The ventilation is a requirement to withstand the heat upon re-entry.

GRISSOM: My area of responsibility is the flight control system and the autopilot. At the time the capsule separates from the Atlas the automatic pilot takes over and puts the capsule in the proper position for orbit, and controls it in its attitude as it orbits around the Earth. This also includes the sensors that sense the horizon in order to control the attitude properly. It includes the reaction controls that are used to change the attitude of the capsule. It includes the hand controller which the pilot can use at his option to control the attitude of the capsule himself, or in the event of an automatic pilot failure he can then control the attitude of the capsule.

GLENN: My area is the cockpit layout, or the astronaut's working space in this. As far as the presentation of instruments, the information from the instruments to the pilot goes, the way we want these laid out, how we want the cockpit organized. This is an area, of course, that had to come up almost immediately as soon as we got on the project, so we have already done quite a bit of work in this field. This is something that had to get firmed up fairly early in the programme.

ALAN SHEPARD
"We are not considering using the flying trapeze method of recovery"



DONALD SLAYTON
[Absent from press conference having picked up "a slight virus"]

It is also an area that is a little difficult to tie down sometimes because it is an opinion area. As any of you who are pilots know, you can get as many ideas on instrument layout as you have pilots to give the ideas. We have had a lot of give and take in this area in firming up the instrument layout for the cockpit.

COOPER: My areas are the ballistic flights with the Redstone missile, both the stability and the performance of the combination of the missile with the capsule on it.

CARPENTER: My area is communications and navigation. The communications end touches on telemetry and voice communications and some of the radar installations, beacons and so forth. Navigation for this mission is about half the job that it would be

Missiles and Spaceflight

SPACEMEN-ELECT . . .

in other applications. It is generally detection of and correction of errors. In our case it is solely a detection, since we don't have the capability of correcting. This touches on maps that we will be using, plus the periscope which gives us the visual presentation of the ground over which we are flying.

In the attitude change, the 180-deg switch, does that come right after going into orbit or before re-entry?

GRISSOM: As soon as the capsule separates from the Atlas it rotates 180 deg into the retro-attitude. In case there is a malfunction at this time, if the speed isn't right up to what it should be for orbit, the retro-rockets can be fired to bring us back in.

At what stage of the flight was the escape tower jettisoned?

SHEPARD: The escape tower is jettisoned shortly after staging. In the case of the Atlas of course that means—

At half staging?

SHEPARD: —when the nose drops off. Shortly after that time. Another means is provided in addition to this for separating the capsule from the Atlas. It is one which doesn't actually show when the capsule is joined to the Atlas. It sits down underneath the grounded body of the Atlas and it is a much lower thrust rocket. At that time of course you would be in an environment which is close to a vacuum.

I would like to know the maximum number of tranverse g's you expect to take on your re-entry, and for what period of time?

SCHIRRA: For the normal mission, where nothing would go wrong, where we didn't have to use any escape mechanism, the maximum g's would be between eight and nine. This would be on re-entry as well as on boosted flight into orbit up to orbital insertions. Of course it would then reduce to zero. The impact g is on the order of about 18 to 20 g; somewhere in there.

How long have you been taking eight or nine g?

SCHIRRA: It is not very long. It is probably about ten or 15 seconds at the most, at the peak. This would be some level about say five or six g, which is a very low order of g, particularly in the position we are in.

Do you think that the first true spaceman will be one of you or the man who flies the X-15?

GLENN: This is something I am glad you brought up on the "first" thing. This is something we all feel very strongly about. We are trying to more or less play down the idea of who will be the first man. I know that this is of big interest to the Press and so on, but we feel that we are all extremely fortunate to be just at this time in history, more or less, where we can take part in such a big venture as this. We feel that this is much more important than whose name happens to be on the first ticket to go . . .

How will the first man be selected? What will be the determining factor?

POWERS: I don't think we have an answer for you right now. If these astronauts maintain their current highly competitive levels of capability, it could well go to lot.

What agency has responsibility for recovery systems and techniques?

POWERS: We have a joint agreement with the Defense Department. Our recovery force is under the Fourth Destroyer Flotilla, U.S. Navy organization, under the command of Admiral Smith, of Norfolk. It is a joint force.

That is the recovery operation. But what about recovery systems? We are confronted with the problem of getting one or more of these fellows to back out of this circle up there. So far, as far as I know, we haven't managed to get a milk bottle back.

POWERS: McDonnell is manufacturing the capsule.

Who is minding the store as far as trying to work out a foolproof system?

POWERS: NASA, the Space Task Group. We have come about as close as anybody has come to recovering any object from orbit in our Big Joe shot about ten days ago at Cape Canaveral. We got near the velocities that we would normally encounter in re-entry from orbit. This was the first of a series of steps in trying to prove out the system.

SHEPARD: Do you think we should explain before we leave this that we are not considering using the flying trapeze method?

Can you give us any idea on when you will have the first manned missile flight?

POWERS: I couldn't begin to give you a date. We must prove out the capsule, push farther down the road on the astronaut training, get more range facilities, and then we will fire it. A lot depends on the upcoming series of Little Joe tests. We may or may not run an additional Big Joe. We will fire when we are ready. Obviously we have a schedule, but it is for purposes of trying to deliver hardware. It must be dependent upon proof. If we prove out the equipment, then we will get ready to fire.

On the recovery system, is the Mercury Project committed to a capsule and parachute, or is it possible that the project as developed may turn into a glider recovery system?

SHEPARD: Insofar as Project Mercury is concerned, we are dealing with a pure ballistic or drag vehicle. As you know, generally after the re-entry phase has been completed and the parachutes deployed, the parachute descent is made for landing. What we are calling Project Mercury includes only this type of vehicle. We are not planning under the name Mercury any lifting type . . .

The X-15 is a lifting vehicle and provides finite control for picking out a landing area. People have asked us a couple of times how we feel about these two philosophies of a lifting vehicle versus a drag vehicle. We feel that actually there are probably two areas where they can be used. You can use a lifting vehicle for V.I.P. transportation and a drag vehicle for the peons.

Col. Glenn, in a certain period of time this programme will be completed. What would you picture your rôle to be after that —go back to the Marine Corps, or what would you do?

GLENN: That is a real good $64 question. We don't know. We are not worrying about that too much. We hardly envision, though, that we are going to get done and be the highly trained nucleus of people that we will be at a time when this project is done, that we will be snatched out of it and put back as Club Officers at Cherry Point or something like that. And I am not casting aspersions on Club Officers at Cherry Point.

Are the astronauts satisfied with the Project Mercury to date? Is the Project Mercury on schedule?

GLENN: Yes

COOPER: Let's put it this way—yes, we are satisfied. Nobody should ever be completely satisfied with any test progress. He should always seek for better. I think that we are satisfied that we are moving along satisfactorily on it. However, everybody would like to see us progress faster, naturally.

Do you think the Russian space achievements will have any bearing on your programme? More money?

GLENN: It will affect it if they will give us the information they got . . . We are not in a drag race with the Russians on getting a man into space. We are not going to put a man up there in a can just hoping to get him back, like—well, I won't say that they will do this, either. But we are not doing that. We won't go until ready whether the Russians go tomorrow, the next day, or a day ahead of us or a day after us. We will go when our project is good and ready to go . . .

POWERS: I think that on behalf of the Space Task Group it is fair to say that we are not unaware of the significance and importance of getting there first, but it is not our only motivation.

A very prominent man in rocketry has made public statements in the southern part of the United States—you can guess who he is—that we have complacency and red tape which are slowing us down in the field of rocketry. I would like to ask if you feel this red tape and are becoming enmeshed in it, and if you feel that complacency is holding you back? Do you agree?

SCHIRRA: I don't see how anyone could legally or even logically in his mind make a statement like that, realizing the great successes we have had. If the man would go around and see where these people are working, and the tremendous effort that is put out in the activity, I don't see how that opinion could be ventured.

POWERS: I think we are talking about two different areas. At our level, so far in our programme, the co-operation and work and response and support that we have gotten from every agency in the country has been almost overwhelming. I think that Dr. von Braun was talking about the high management finding and procedural matters as opposed to our working-level situation. At our level we don't see it.

Your one-vision out is the periscope. Are there any turrets planned in the capsule, transparent ports so that one can look out, if you pardon the expression, with the naked eye?

SHEPARD: I will pardon the expression. Yes. Actually the periscope can be used for two purposes. It can be used as a navigation instrument, also for general observations. In addition to that—which can be interpreted to be a back-up, if you will—will be a port through which the pilot can view the surroundings. The port is a fixed window. It has to be very carefully designed because of structural and heating considerations. Even though it is fixed, the pilot will have the capability of locating the capsule in various attitudes so that he can observe through this fixed window in whichever direction he desires. Of course, I think you can realize that this is a back-up, using the naked eye, for any kind of flight attitude or rate-indicating system.

Aeronautical Bookshelf

Nine Lives, by G/C. Alan C. Deere. Hodder & Stoughton Ltd., London, E.C.4. Price 15s. Illustrated.
Yellow Belly, by John Newton Chance. Robert Hale Ltd., 63 Old Brompton Road, London, S.W.7. Price 16s.

Two men's wars: one, the story of a New Zealander who came to Britain in 1937 to join the R.A.F., trained as a fighter pilot and flew and fought with great distinction through Dunkirk and the Battle of Britain to the days when Fighter Command took the offensive and he led sweeps from Kenley; the other, a less epic (but no less admirable) account of wartime training as a pilot and instructional duties on Oxfords.

G/C. Deere, the professional airman, writes unaffectedly of his combats and his escapes (the latter achieved both by skill and by luck, his slices of good fortune being fully deserved): his simple narrative does more than heroic ghost-writing could to underline the likeability of this gallant and determined New Zealander. John Newton Chance, the professional writer, tells his story with a quiet sense of humour and has a good eye for character, particularly when observing Regulars as seen by a non-Regular.

Both men had their psychological problems: Chance's a dread of night flying, which he subsequently overcame; Deere's a bad patch when his first command, a Canadian squadron, suffered a sharp defeat and was withdrawn from operations—though he subsequently went on to become a brilliant wing leader. Two men's wars, and out of them two highly interesting stories.

H. W.

The Seven Skies, by John Pudney. Putnam & Co. Ltd., 42 Great Russell Street, London, W.C.1. Price 30s. Illustrated.

PUBLIC RELATIONS is still a vague art; it is difficult to define it more closely than as an effort to secure a favourable image in the public eye. This "study of B.O.A.C. and its forerunners" was commissioned by the Corporation's chairman, Sir Gerard d'Erlanger, with the presumed object of spreading the name and fame of his airline. Judged in this narrow light—as a public relations medium—this work will probably be voted a success, for most readers will carry away a feeling that B.O.A.C. is "a good thing."

Those unfamiliar with such names as Holt-Thomas or Woods Humphrey or Brackley will find *The Seven Skies* an admirable introduction to Britain's airline industry. Indeed, it is probably true that no other single book offers such a palatable and comprehensive record of British air transport. And it is not only a book for outsiders: of those close to the industry few will fail to enjoy Mr. Pudney's prolific anecdotage.

Even so, the work suffers from two weaknesses. In the first place, less than a quarter of its length has been devoted to the post-war B.O.A.C., and many rewarding fields are consequently unexplored. More could have been said, for instance, about the Corporation's present organization and operations. Secondly, the author has—understandably—refrained from adopting a critical attitude towards his subject. Sometimes this is apparent in patches of text which appear to have been lifted bodily from annual reports and press handouts. At other times it results in avoidance of controversy: the complex situation that led to the creation of B.O.A.C. is hardly touched upon; and no reference is made to such crucial current problems as aircraft procurement or workshop reorganization.

J. C. S.

Knight of the Air. The Life of Antoine de Saint-Exupéry, by Maxwell A. Smith. Cassell and Co. Ltd., 35 Red Lion Square, London, W.C.1. Price 18s.

SAINT-EXUPÉRY's biographer seems to know very little about aeroplanes. Describing a trial night landing at Orconte, after experimental airfield lighting had been installed there, he writes: "Then they heard the engines at full speed and saw the aircraft almost in a tailspin, trying to regain altitude." Again, when "Saint-Ex" was flying Lightnings: "It was the custom of the squadron shortly after the take-off to draw their petrol from two large tanks attached underneath the plane. Saint-Ex set out one day in an aircraft which had only one of these reservoirs, but he had not noticed this and flew as usual. After a time, of course, the engine got no more fuel, but since the wind was making the propeller revolve at a certain speed, Saint-Ex merely thought that he was losing part of his power and calmly set his aircraft down on the ground, surprised to observe that his propeller was no longer turning as he braked the plane."

Such descriptions hardly become a book about a distinguished airman, and some of the translation has a correspondingly amateur ring. Another matter for criticism is that this biography (revised and enlarged from the original version, published in the U.S. during 1956) contains no maps, which would have been useful in following the career of a man who helped to pioneer air routes in North and West Africa and South America. It is a pity, too, that the portrait used of Saint-Ex himself is a rather unsatisfactory side-face view. Occasional mis-spellings occur, such as "El Aonima" for "El Aouina" and "payed" for "paid."

With these reservations, it may be said that this is a reasonably successful biography; though with a subject whose writings were so autobiographical, who could fail to achieve some sort of success? The danger, which Mr. Smith does not always avoid, is that of falling into a dazed kind of hero-worship.

Saint-Ex endured some terrifying and terrible experiences. He had a near-fatal accident when test-flying seaplanes; when on a flight from Paris to Saigon he and his mechanic forced-landed in the Western Desert and had four days' parched and delirious wanderings before being rescued by a Bedouin; when flying for the Aéropostale in North Africa he and his fellow-pilots were continually subject to aircraft unreliability and Arab unpredictability; and in South America they had to contend with great winds and high mountains in machines that by today's standards were pitifully under-powered.

Out of these experiences Saint-Ex produced some of the world's finest aviation literature. His *Night Flight*, *Flight to Arras* and *Wind, Sand and Stars*, for example, are acknowledged classics. The second-named has as background reconnaissance flying during the German advance in 1940. Four years later, at the age of 44, Saint-Ex was with a French Air Force reconnaissance group operating from Corsica with Lightnings. He failed to return from a sortie and it was later established that he had been shot down. Two days earlier, when his friend Gen. Chassin had tried to persuade him to give up flying, Saint-Ex had answered: "It's impossible. I'll go on to the end now. It isn't very far away, I think."

H. W.

Across the Alps. Published for Swissair by Kümmerley and Frey AG, Bern. (London: "Geographia" Ltd., 167 Fleet Street, E.C.4. Price 65s). Illustrated.

THIS magnificently produced collection of nearly 100 photographs (page size 9in × 12in) of the Alps, some in colour, each accompanied by a detailed caption and the whole preceded by a key map and by three articles by experts, will be of the greatest interest to mountaineers, geologists and all who love the high places. Its aeronautical interest is secondary: not immediately apparent is the fact that every one of these splendid pictures is an air-to-ground photograph. They are from the collection of Swissair photographer Werner Friedli and most of them were taken from a Piper Super Cub. The whole of the text is in English.

Aircraft Electrical Engineering, edited by G. G. Wakefield. Chapman & Hall Ltd., 37 Essex Street, London, W.C.2. Price 50s. Illustrated.

HERE is one of a technical series inaugurated by the Royal Aeronautical Society. It is the first of its kind to be published in this country, in that many problems which beset the engineer who ventures into the realms of aircraft electrics are each discussed by an experienced engineer in that field.

Subject matter ranges from the environmental conditions under which aircraft installations must continue to function correctly—including that tough problem, vibration—to a discussion on the relative merits of A.C. and D.C. generating systems. The reader readily appreciates that a great deal of practical experience lies behind the contributions to this volume.

The feature of correlating aspects of engineering which in other fields are hardly appreciated by the electrical engineer makes the book of outstanding value, both to the student and to the practising aircraft electrical man.

Interest would have been further sharpened if the treatment of advanced systems and future concepts had been as comprehensive as that of established practice. For instance there is little discussion of the development of the constant-frequency A.C. systems now operating on many of the most important military and civil aircraft, and no mention at all of the part played by the ubiquitous transistor and by those other semi-conductors the zener diode and silicon-controlled rectifier. These devices have made possible the production of lightweight generating channel control systems, designed on computer lines which require no action on the part of the aircrew in normal functioning and fault-clearance duties. This point apart, the book will be of great use to all engaged in applying electrical engineering projects to an airframe.

T. E. H.

Aircraft Electricity for the Mechanic, by Charles Edward Chapel. Aero Publishers Inc., 2162 Sunset Blvd., Los Angeles, Calif. Price $5.00.

THIS bright American book was written by a well known teacher of aircraft electrical technology whose students were mainly Service personnel. Its breezy style is calculated to hold the interest of readers who are not necessarily academically minded but whose efficiency as electrical mechanics, riggers and inspectors would benefit from an appreciation of the principles of electricity and their applications and use on aircraft.

The status of the subject matter approximates to that of the first-

(*Concluded at foot of page 430*)

AID TO OTOPIA

EXERCISING AERIAL SUPPORT TACTICS

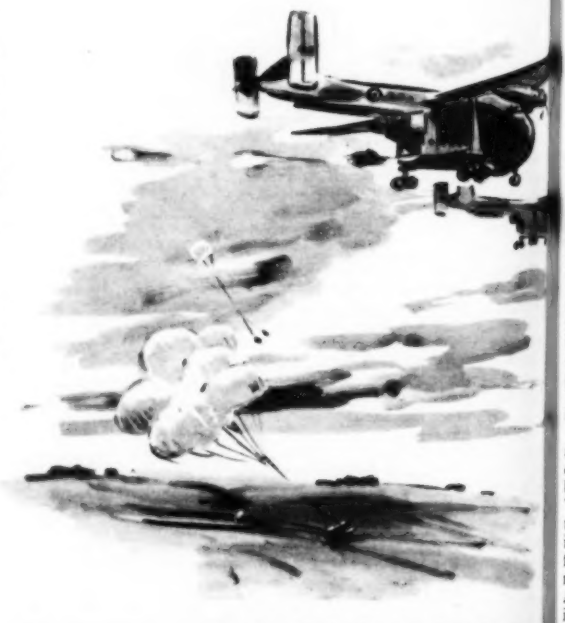
Drawings by Gordon Horner

Explaining the logistics side of "Red Banner": Lt-Col. D. Wilson, A.A. and Q.M.G. at 3rd Division Headquarters, gives a briefing at the School of Infantry, whose badge can be seen in the background

AN imaginary conflict between the neighbouring states Otopia and Salsbodia, and the former's appeal for British assistance, provided the theme for last week's five-day Army/R.A.F. exercise called "Red Banner." Its aim was "to test the tactical handling of a brigade group of the Strategic Reserve equipped for air transporation, and to test the effectiveness of second-line administrative support based on helicopters." Maj-Gen. Gordon Lennox, G.O.C. 3rd Division and director of the exercise, explained that its title had no significance; and he stressed in his preliminary briefing that all aspects of Red Banner were experimental and did not represent official policy. "This is a test exercise," he said; "there is no doctrine here that has been proved. It is a test to see if we can maintain a brigade group by helicopter. If we can do that it gives much more flexibility for quick intervention." Emphasizing the importance of helicopters —with them, he said, "you're much less dependent on physical obstacles"—he summed-up the airborne aspect of Red Banner by saying: "We have tried various links in the chain but never tried the chain as a whole."

The chain referred to had three links—between a supply base and forward airfield, between the airfield and Forward Maintenance Area, and between the F.M.A. and troops at the front. In Red Banner, the supply bases were Abingdon and Lyneham, the forward airfield Keevil—re-activated for this occasion—and the F.M.A. about a ½ mile from it. The first link was maintained by Beverleys and Hastings of Transport Command (these aircraft also dropping troops and equipment on the first day of the exercise), the second by road and the third by helicopters. Three types of helicopter were employed on this airlift: Sycamores and Whirlwinds of the Joint Experimental Helicopter Unit and H-34s of the U.S.A.F., which had flown over from Germany. In addition a Bristol 192 and Westland Westminster participated. Further air co-operation was provided by Sea Venom ground-attack fighters and Sea Hawk tactical reconnaissance aircraft from R.N.A.S. Yeovilton, and photographic reconnaissance Canberras from R.A.F. Germany: they played a part in the land battle —Red Banner proper—which was distinct from the airborne exercise, though both were planned in the same time-schedule and were complementary operations.

Airborne deployment and supply was carried out in three phases: first, the Beverleys and Hastings dropping troops and equipment; secondly, the same aircraft landing men and supplies; and, thirdly, the helicopter supply-line to forward areas. On Monday afternoon last week a single Hastings initiated the air-drop, made at a point on Salisbury Plain about four miles east of Warminster: on two runs, it dropped 15 pathfinders to lay out the personnel dropping-zone, then 14 more to position the heavy drop D.Z. Sixteen Hastings followed, flying in "loose pairs" with a 15 sec interval between each pair. These aircraft had aboard the 1st battn. group of the Parachute Brigade, with brigade



Beverleys dropping heavy equipment in support of the 16th Independent Parachute Brigade Group at the start of the exercise

A Beverley from Abingdon being unloaded at Keevil airfield by R.A.S.C. personnel using fork-lift trucks. Quickest time from engines off to re-start was ten minutes

Down into battle: parachute troops drop into Otopian territory in support of its appeal to Britain for help against Salsbodian invaders

headquarters, each machine carrying 30 men who jumped out of opposite sides in sticks of fifteen. Nine Beverleys each dropped 20 men (coming out singly) and on a second run released two medium platforms, a typical load for these platforms being two Land Rovers. It takes about a quarter of an hour for these vehicles to be de-rigged and driven off. In the total time of the air-drop (approximately 40 min) about 720 men were successfully deployed.

Once the Parachute Brigade Group was in the field, representing a British answer to Otopia's call for help, attention concentrated on reinforcing and supplying them. In the words of a senior logistics officer, Lt-Col. D. Wilson, at a briefing on the following morning: "We are trying to move in [by air] everything they are going to eat and shoot, and the petrol they are going to use." This amounted to 105 tons per day plus a 50 per cent reserve, i.e., a daily total of some 150 tons for about 3,000 troops.

The first aircraft on this supply-line, Beverleys with tractors and trailers aboard, came into R.A.F. Keevil just before 7 o'clock on Tuesday morning last week and was unloaded in 14 minutes by R.A.S.C. personnel of FASO (forward air supply organization). The second aircraft was unloaded in 12 min and later in the day this time, calculated from the moment the engines stopped, was improved to ten minutes. For the first time on an Army exercise, fork-lift trucks were used, which loaded on to ordinary commercial vehicles for road transfer to the Forward Maintenance Area. During the time the Beverleys were coming in and unloading, Hastings aircraft were air-landing troops to support the parachutists. Among the official spectators at Keevil was the A.O.C.-in-C. Transport Command, Air Marshal Sir Denis Barnett, who expressed himself satisfied with R.A.F. participation so far in the exercise. This participation involved eight squadrons—Nos. 47 and 53 (Beverleys), 24, 36 and 114 (Hastings) and 17, 31 and 80 (Canberras), co-operation with the Army in the jointly-run J.E.H.U. support, and the staffing of Keevil for its temporary rôle. The Hastings and Beverley aircraft taking part in Red Banner had only recently been engaged in the Anglo-Norwegian exercise Bar Frost.

At the F.M.A. the helicopters being employed on the forward airlift were tactically dispersed, though this dispersal area was tactically compressed, since—as Col. Wilson pointed out—the Army was working on private land and not on W.D. property. He further said that no ack-ack defence was included, as Red Banner was an exercise "written in the setting of an enemy with no air power." The variety of types of helicopter used, he commented, didn't make the job of loading them any easier. Special hooks were being used for picking up and putting down the Whirlwind and Sycamore loads, amounting to 1,000 lb—an unfavourable contrast with the 3,000 lb carried by the U.S.A.F. H-34s. (The Army has clearly got its eye on the Westland development of this aircraft, the Wessex, with a sling-load capacity of 4,000 lb).

Air supply to advancing troops is a one-way traffic, and the only loads brought back by the helicopters were casualties. They were returned from the battle area to an Advanced Surgical Centre and after treatment there flown back to Abingdon, subsequently coming back as fit soldiers and being "processed" through to their units.

During the remaining days of the exercise its two aspects—air supply and ground manœuvres—went on simultaneously, with the helicopters having a clear run in the sense that the opposing forces had no aircraft to put up against them. This was fortunate,

Artist's-eye view of the battle: Gordon Horner with Capt. T. A. Taffs, 651 Light Aircraft Sqn., in an Army Air Corps Skeeter

AID TO OTOPIA . . .

for with only 16 helicopters doing a regular shuttle service—eight Whirlwinds, four Sycamores and four H-34s—the troops dependent on them for supplies could have hardly afforded to lose any.

* * *

In effect, Red Banner not only showed what could be done with an aerial supply pipeline formed by fixed-wing aircraft and helicopters but also what could not be done by the Army's at present woefully inadequate helicopter resources. Neither of the two larger helicopters in current Service use, the Sycamore and Whirlwind, can carry a worthwhile load; and in the event of a conflict a thousand or two thousand miles overseas, how are the support aircraft to be got to the scene of operations in time to be of any use? On the score of size, the Army is clearly interested in the Wessex, which has a quite useful payload; and when it comes to weight-lifting the Bristol 192 and Westland Westminster —civilian visitors to Red Banner—are obviously strong contenders. The Fairey Rotodyne supplies a further quality, forward speed, and has much to recommend it for military application. A proper answer to the Army's need for a close-support aerial supply vehicle must be found soon, and once a decision has been made a sufficiently realistic number should be ordered.

* * *

At the end of Red Banner the G.O.C-in-C. Southern Command and Commander of the Strategic Reserve, Lt-Gen. Sir Nigel Poett, said that air supply of units in the field gave greater flexibility—and more economy—than a land-based system. For example, because of its speed, requirements by units could be changed up to the last minute according to fluctuations in the battle. But aircraft still could not be expected to lift really heavy military loads, such as tanks, and carry them long distances as part of a strategic reserve. During Red Banner, as an exercise in supply by helicopters, emphasis had been placed on making individual items of equipment—from howitzers to combat suits—lighter in weight in the interests of air portability. But even when this had been done, vehicles were needed to shift heavier stores. A smaller exercise (Black Gnat), using STOL aircraft instead of helicopters, had been carried out by 19 Brigade in the week before Red Banner and proved "equally successful." Early in December a brigade group from 1 Div. was to do another air mobility exercise in Northern Ireland, and next year it was hoped to learn "even more useful lessons" by moving farther afield. As Maj-Gen. Lennox had done at the beginning of Red Banner, Lt-Gen. Poett stressed

Sea Venoms of No. 894 Sqn., R.N.A.S. Yeovilton, over Scots Guards positions. Elements of the 1st Guards Brigade Group were "enemy" (Salsbodian) forces in Red Banner

the test nature of these exercises. "Our function as a strategic reserve," he commented, "is to experiment and advise: decisions are taken by the War Office."

* * *

From Black Gnat and Red Banner it should have become reasonably clear what type of aircraft, and how many, the Army needs to give its strategic reserve a realistic amount of air mobility. The decisions spoken of by the G.O.C-in-C. should be taken quickly, and with an eye to military requirements at least five years ahead.

H. W.

AERONAUTICAL BOOKSHELF (continued from page 427)

year National Certificate course. It is enlivened by humour which would cause pleasant surprise if found in a British text-book; for example, during a discussion on landing-gear warning circuits, it is recorded that, after landing with his wheels retracted, a pilot explained that he could not hear a thing the tower was saying because of that "damn horn blowing so hard!"

Following the explanations of fundamentals and their applications, the book goes on to discuss aircraft instruments and circuits, including ignition systems. Installation practice and organization of inspection and the duties of an inspector are covered, the latter discourse including typical aircraft inspection charts. The final chapter emphasizes the spirit of the book. It is called "How to get a job," and provides a common-sense approach to this important aspect of life.

T. E. H.

Jets and Rockets, by A. Barker, T. R. F. Nonweiler and R. Smelt. Chapman and Hall Ltd., 37 Essex Street, London, W.C.2. Price 35s. Illustrated.

THIS book is British, and it is high time someone pointed out that we have not been idle in the fields of rocket and ramjet propulsion. But one is disappointed. The discussion of the rocket motor is centred about the German A.4 and Walther HWK.509AS, and the familiar drawings are reproduced yet again. There are pictures of some early British engines such as the Fairey VTO, but no mention at all of the Screamer, Spectre, Scorpion or Gamma. The whole chapter is sadly out of date.

The section upon turbojet propulsion is more rewarding. The momentum theory is simply and clearly presented to show the basic difference between rocket and turbojet propulsion. The fundamentals of the turbojet are adequately explained, although the turbine is worthy of lengthier treatment. It is regrettable that the author chooses to illustrate some of his points with pictures of the W.1A and W.2 engines! The theoretical material is largely concerned with overall performance, and this part of the book is good, presenting comparative data up to Mach 3. There are short sections on the ramjet, the impulse duct (now used in model aircraft), and on combined powerplants. Two unusual and welcome chapters in a book on propulsion are those on air intakes and air resistance at high speeds. The latter is, in this reviewer's opinion, the best chapter in the book, and as a potted introduction to high-speed aerodynamics would be difficult to better. A chapter on rocket projectiles is singularly weak, and should have been left out altogether, or brought up to date. The authors' remarks on spaceflight appear to have been written four or five years ago, and have that superior scepticism of the "spaceflight is bunk" school.

Yet there is much of great value in the book; theoretical matter is presented clearly and concisely, and never becomes clouded by unnecessary detail. In spite of its shortcomings, and the variety of styles of the three authors, the book is worth its price to students and propulsion engineers, and even the semi-technical man will find little in it incomprehensible. The bibliography at the end contains most of the classic references (but there are very few later than 1955).

H. M. B.

Dictionary of Guided Missiles and Space Flight, edited by Grayson Merrill. D. Van Nostrand Co. Ltd., London, W.14. Price 131s 6d. Illustrated.

A WORK of this nature has been needed for many years past, as much in the field of ordinary aviation as in the more specialized realm upon which Captain Merrill's *magnum opus* concentrates. In the publisher's announcement it is stated that the work "defines and explains the most commonly-used terms in the guided-missile and space flight fields today." Such a task is monumental, and many contributors have assisted in compiling a formidable array of technical terms, more or less well-chosen and in general adequately discussed.

One of the most difficult tasks in compiling any form of dictionary is to know where to leave off; and when this work defines, for example, "reduction of area" (in material subject to stress) and "dirigible" it surely goes beyond its terms of reference. Another weakness is that in a table of American guided missiles an extraordinary amount of information is missing, notwithstanding clearance for publication by the U.S. Defense Department. Several of the characteristics quoted are quite erroneous; two adjacent examples are the length of 20ft quoted for Sergeant and the fact that the data for Regulus II actually applies to Regulus I. These are, however, carping criticisms, and it is certainly true to say that many engineers will find this dictionary of inestimable value.

The typography, presentation, diagrams and cross-references set a high standard, and the utility of the work is enhanced by the fact that a strict A-Z sequence is maintained from the first page to the last.

W. T. G.

IN the sub-title below, the initial letters SAGW signify "surface-to-air guided weapon." At the outset it must be made clear that the complete SAGW system includes special radars, fire-control equipment, ground-handling gear, workshops, storage, launchers, control posts and, by no means least, a highly trained team of operators—and a missile. It is now proposed to outline the history of the Bloodhound system and, within the limits imposed by security, to describe its function as a vital defender of the United Kingdom against attack by manned aircraft.

An authoritative history of the entire project was read by David Farrar (chief designer, guided weapons, Bristol Aircraft) before the Guided Flight Section of the Royal Aeronautical Society a year ago; his paper, entitled *The Bloodhound*, appeared in the Society's *Journal* for January last.

It is worth emphasizing that, when the programme started, other companies were already well advanced with the development of similar weapon systems for the Navy and Army. The latter were the Seaslug and Red Shoes (Thunderbird); the new missile system

BLOODHOUND

The SAGW System of the Royal Air Force

Fig. 1. Boost separation of the production weapon

for the R.A.F. was given the code name Red Duster, and its development was entrusted to the Bristol Aeroplane Company and Ferranti Ltd. From the beginning Bristol and Ferranti worked as equal partners, and both have borne witness to the success of this arrangement.

Initial stages of the project can best be related by Mr. Farrar himself. He said:—

"The general considerations taken into account were the need for high fire-power and the use of tracking radars which did not impose major radar development problems. For reasons of ability to achieve long range the guidance system had to permit much of the missile flight to be at high altitudes, and for accuracy of interception at long range the use of homing was essential. All these requirements were met by the use of semi-active homing from launch. In this system, the target is illuminated by a ground radar while a receiver in the missile is locked on to the reflected signal from the target. The missile is not then constrained to follow a line-of-sight trajectory, and the fire-power is not limited by the number of radars available.

"The use of rocket, ramjet or turbojet was considered. The ramjet was competitive with the rocket at short ranges and gave great range development potential because of its lower propellant consumption. The expendable turbojet engine was not competitive at any range. The choice of ramjet propulsion was therefore made on grounds of performance, although not without some misgivings from the point of view of development time since supersonic ramjet propulsion had not then been achieved in this country.

"No attempt was made to design a weapon system at once, and attention was concentrated on building up the engineering team and establishing the techniques of guidance and propulsion. Two test vehicles, initiated by the Royal Aircraft Establishment and subsequently developed by the firms, enabled this to be done. Firings of both types of test vehicle began less than six months after the decision on choice of guidance and propulsion had been made."

As is invariably the case with a major G.W. development programme, specialized test vehicles were evolved in order to prove individual functions. To assist in the development of the control system, Ferranti employed the CTV-4, which was flown in guidance, control and parachute-recovery experiments. Displayed anonymously at the S.B.A.C. show in 1956, CTV-4 was a simple unpowered Dart with cruciforms of wings and aft control surfaces, indexed in line. It could carry a homing receiver and, after acceleration to supersonic speed by a tandem boost, its trajectory could be controlled via an actuator block and the cruciform tail fins. Much difficulty was experienced in achieving satisfactory reliability with these vehicles; at the time of their design no super-miniature valves were available, and the complexity of the circuits and the difficulty of fault-finding caused appreciable delays. Nevertheless it is fair to state that, by learning the hard way with CTV-4, Ferranti were able to evolve techniques which are today largely responsible for the reliability of the airborne guidance system of Bloodhound as a whole.

While these studies were going on, Bristol Aero-Engines (now Bristol Siddeley Engines) started their investigation into the propulsion system. At the outset the Engine Company had collaborated with the Boeing Airplane Company in the field of ramjet propulsion, and by about 1950 were undoubtedly in possession of more design information on supersonic ramjets than any other firm in Europe. Their first task was to decide how many engines to employ and how they should be installed.

To begin with, Bristol Aero-Engines studied a simple 6in-diameter unit (doubtless the largest size which could readily be handled at that time) and, after basic rig-testing, began to fly a pair of these engines on the JTV-1 test vehicle (Fig. 2). After severe initial structural problems with the airframe—Mr. Farrar recalled that the JTV-1 was once known as "the only fully separating test vehicle"—several families of JTV were made to work, and it finally became the first British flying machine to be sustained at supersonic speed by ramjets. After thus initially proving the system of propulsion, an overall look was taken at three basic configurations (Fig. 3). The integral ramjet with a nose intake left little space for tankage and guidance, and also seemed likely to engender severe vibration, while the design with side intakes would then have involved too many unknowns for it to be attractive. Accordingly, development proceeded on a twin-engined weapon, roughly according to configuration X. By this time it had also been decided that, in view of the fact that a long range was demanded, ram-air turbines should be used to drive the fuel pump, hydraulic pump and alternator.

Having elected to use more than one engine, the question next arose of how many wings to employ and what form these should take. At this time all other British missiles had fixed wings, moving rear control surfaces and cruciform surfaces (i.e., four wings and four fins each indexed at 90 deg to its neighbours). Notwithstanding this, calculations showed that the best overall results could be obtained by employing a monoplane moving wing; not only was this the neatest arrangement in view of the twin ramjets, but also it gave much shorter response times without suffering from the radome aberration effects suffered by the fixed-wing vehicles. Choice of a monoplane configuration at once imposed the twist-and-steer form of manœuvring. Mr. Farrar has described the reasons for such a choice in the following terms:—

"A Cartesian missile manœuvres so as to achieve a collision course

(*Continued on p. 434, after double-page drawing of Bloodhound*)

Fig. 2. A JTV-1 on its launcher

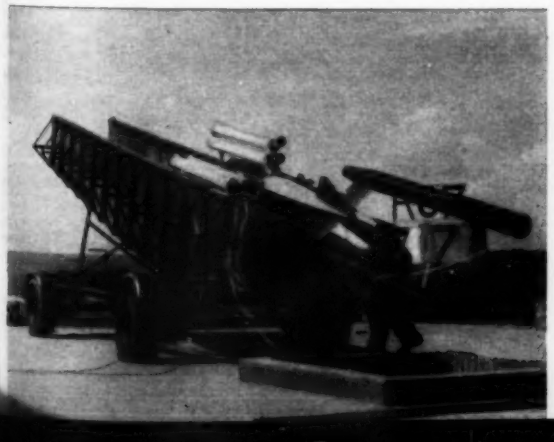
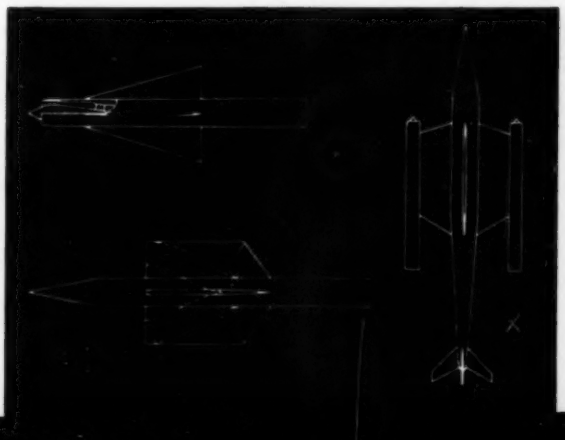


Fig. 3. The three basic configurations



BLOODHOUND

BODY

1 Dielectric nosecone
2 Hydraulically operated scanner
3 Nosecone frame dogged to inner structure
4 Removable outer structure (riveted to nosecone and pressurized)
5 Front frame, electronics bay (light-alloy casting)
6 Channel members supporting segment carriers
7 Removable segments (electrics, guidance, control)
8 Hydraulically driven tandem alternators
9 Indicator lights
10 Removable outer section firing bolts
11 Pressure bulkhead
12 Cable runs and hydraulics to alternator and scanner drive
13 Assumed position of proximity fuze windows
14 Warhead bay
15 Removable upper section
16 Inspection panels
17 Bulkhead
18 Cable duct through casting
19 Cable runs
20 Hydraulic pipe runs
21 Main casting (carries mainplanes, actuators and engine supports)
22 Heavy-gauge skin (monocoque structure)
23 Main longerons
24 Mach-number control unit (meters fuel on reaching cruise Mach number)
25 High-pressure hydraulic accumulators (supply oil during turbine spin-up)
26 Oil delivery from accumulators
27 Accumulator cast bracket
28 Low-pressure hydraulic accumulator
29 Oil to l-p hydraulic accumulator
30 Nitrogen pressure supply
31 Aft-body casting (carries tailplane and rear engine brackets)
32 Ground air-cooling
33 Tail frame casting (carries boost cluster slide-off ring)
34 Ground supply, hydraulics, nitrogen, cooling air
35 Ground supply socket (electric)
36 Single upper and lower skins
37 Tailplane spar bolted to frame

WING

38 Hydraulic supply to actuator
39 Hydraulic return
40 Wing-pivot bearing
41 Spar dogs
42 Spar
43 Spar retaining pins
44 Retaining pin lock screw
45 Wooden matrix
46 Matrix bolted to spar
47 Light-alloy leading edge strip
48 Upper and lower skins (riveted together through matrix)
49 Hydraulic wing lock (locked during launch phase)
50 Skins riveted together at trailing edge

BOOSTERS

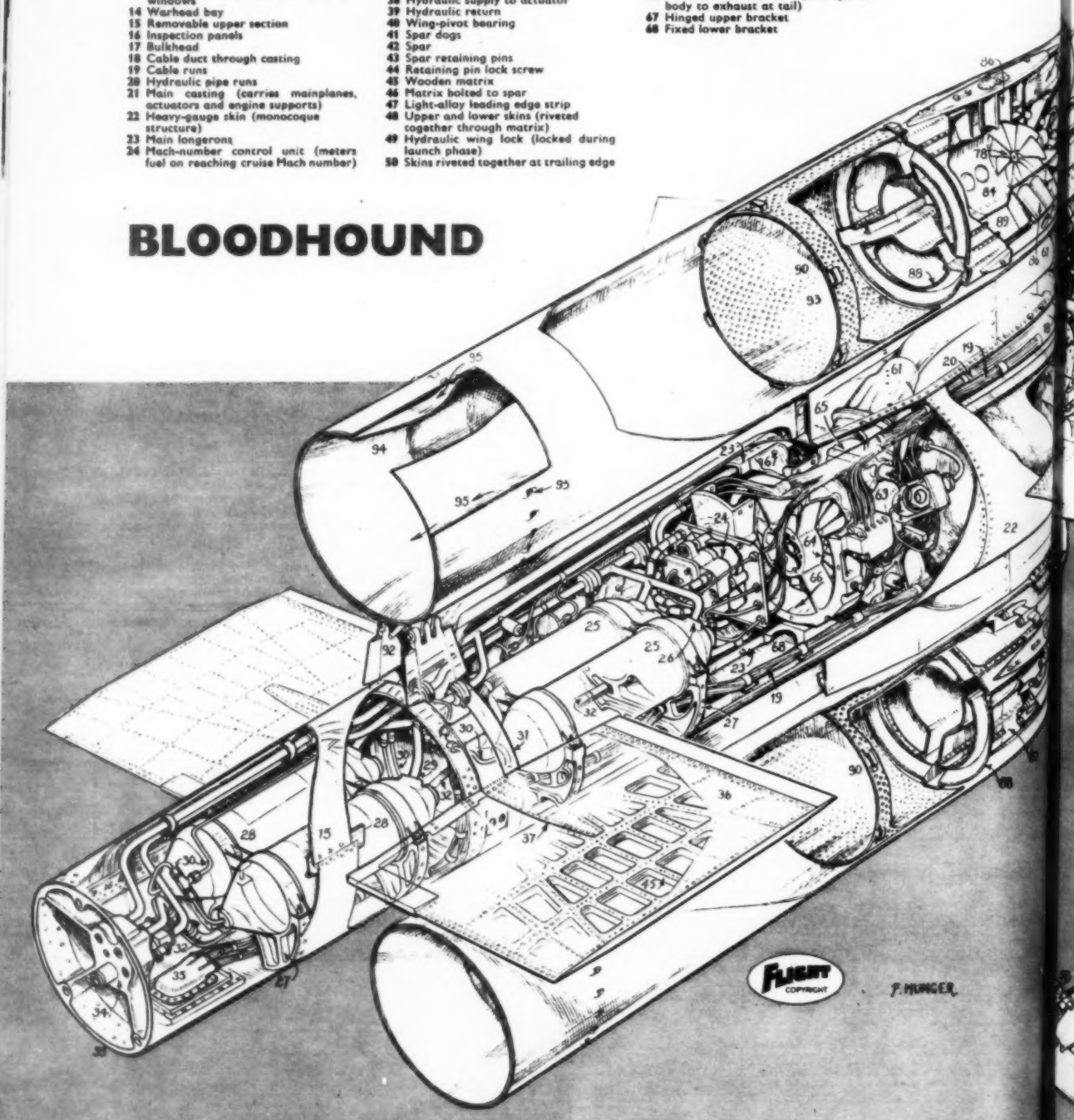
51 Igniter cables to boost motor
52 Booster front retaining shoe
53 Booster slide-out retaining feet
54 Lift-off vanes
55 Launcher mounting bracket
56 Rear hinge
57 Slide-off ring (transmits boost thrust, slides off as boost dies)
58 Jettisoned boost cluster as ramjets take over after light up

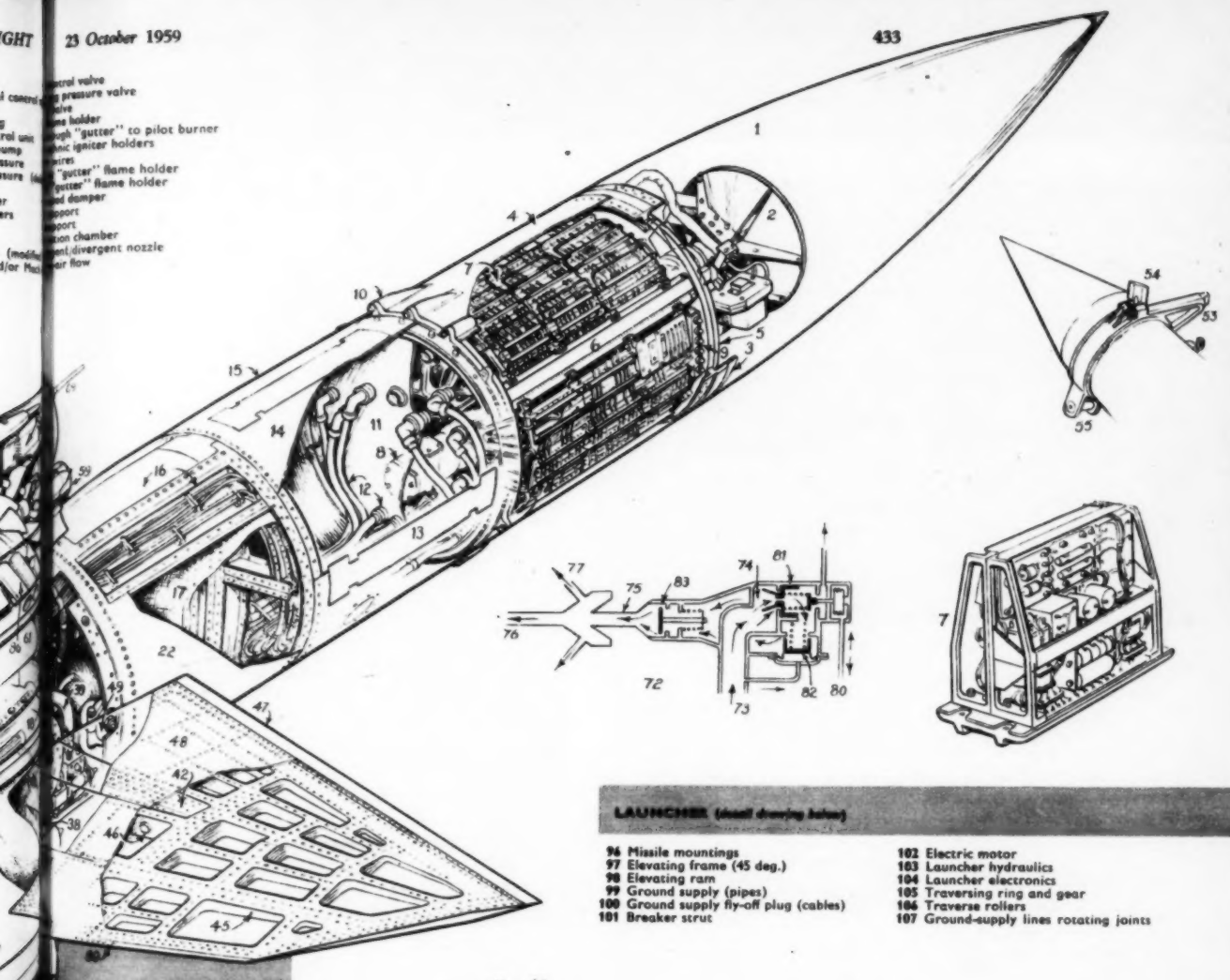
AIR TURBINES

59 Stub-wing ram-air intake
60 Ram-air to fuel pump turbine
61 Ram-air to hydraulic pump turbine
62 Turbine driven fuel pump
63 Turbine driven hydraulic pump
64 Turbine rotor
65 Ram-air relief valve
66 Turbine exhaust air (through aft body to exhaust at tail)
67 Hinged upper bracket
68 Fixed lower bracket

RAMJETS

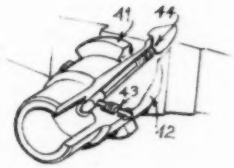
69 Pressure head (fuel control
70 Intake shock cone
71 Island front casting
72 Fuel/air ratio control unit
73 Fuel supply from pump
74 Pump delivery pressure
75 Downstream pressure (
burners)
76 Fuel to pilot burner
77 Fuel to main burners
78 Pilot burner
79 Main burners
80 Control pressure (modi
potentiometer and/or M

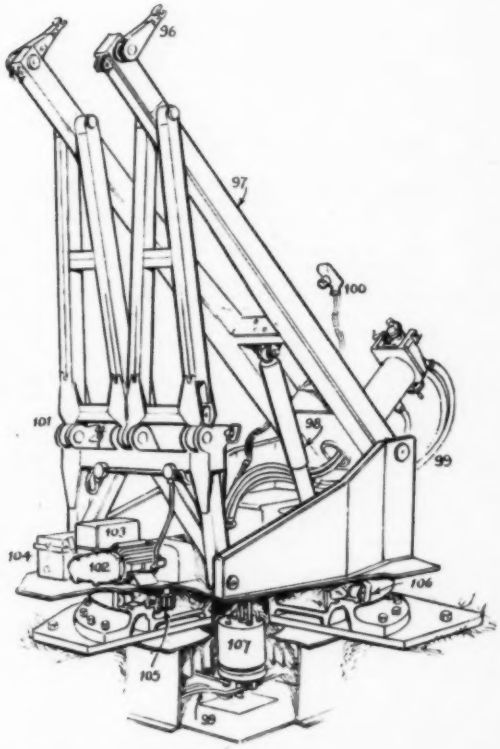


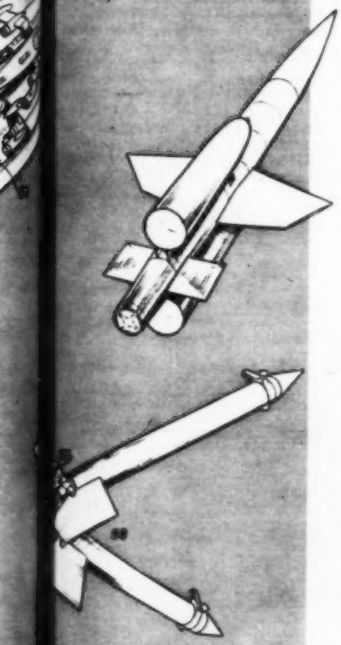


LAUNCHER (detail drawing below)

96 Missile mountings
97 Elevating frame (45 deg.)
98 Elevating ram
99 Ground supply (pipes)
100 Ground supply fly-off plug (cables)
101 Breaker strut
102 Electric motor
103 Launcher hydraulics
104 Launcher electronics
105 Traversing ring and gear
106 Traverse rollers
107 Ground-supply lines rotating joints







The main drawing on these pages has been prepared by a "Flight" artist from a variety of sources. Owing to consideration of security certain areas such as the warhead and tankage have not been illustrated in detail; and for the same reason the powerplants shown are of the early BT-1 pattern, rather than the current Bristol Siddeley Thor ramjets used on the operational missile. Inset diagrams show the fuel-control system, a typical portion of the airborne guidance, the nose of a boost motor, a wing spigot, the separation of the boost motors and the launcher

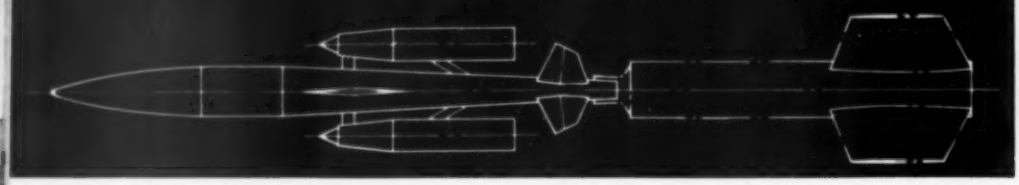


Fig. 4. Original configuration of Bloodhound. The missile occupied 20ft of the total length of 32ft 7in

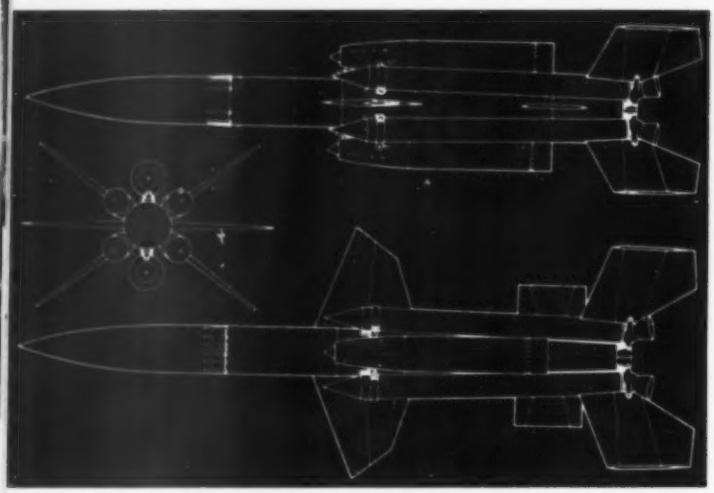


Fig. 5. This drawing of the final production Bloodhound Mk 1 forms an instructive comparison with that above. Dimensions are: length overall, 300in; length without boosts, 266.42in; body diameter, 21.5in; wing span, 112.5in; wing root chord, 45.5in; tailplane span, 35in; tailplane chord, 30in; overall height across ramjets, 57.78in

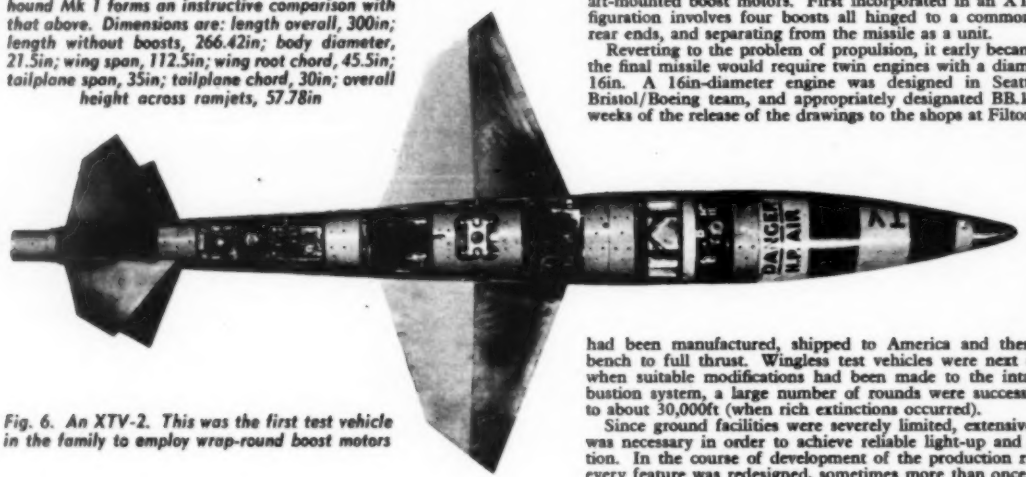


Fig. 6. An XTV-2. This was the first test vehicle in the family to employ wrap-round boost motors

BLOODHOUND . . .

separately in each manœuvre plane. The miss-distance can be increased by missile response lags and by cross-couplings, such as those between pitch and yaw manœuvre affecting the roll stabilization upon which the system fundamentally depends. A twist-and-steer missile rolls so as to align the normal to the wings with the vector direction in which manœuvre is required, and develops the manœuvre by pitching. The only major cross-couplings are gyroscopic forces. Much remains to be said on the philosophical difference between these systems. Certainly the twist-and-steer arrangement is the one favoured by nature in all birds and nearly all fish. It does possess the advantage of being redundant, in that a failure of either pitch or roll control can still result in some sort of interception course, whereas a failure in one plane of a Cartesian missile is catastrophic.

"The characteristic time-lag in roll response of a twist/steer missile can be made much less than that in pitch. One might expect that a more accurate interception would therefore be possible, and this is true, provided that resonance instability due to gyroscopic forces is avoided by suppression of body motion in a moving-wing missile. Otherwise, the roll rate may have to be kept below the pitch or yaw frequency, and the miss-distance performance will then not be superior to that of a Cartesian system, except for reduction of cross-couplings. (This does not necessarily mean, however, that the kill probability is not higher.)"

Finally, having adopted the configuration described, a compromise had to be struck between the size of the wing (and hence manœuvrability at altitude) and the size of the homing head, and in particular the size of the receiver dish aerial. It is desirable to make the latter as large as possible, since this not only gives better information on target position (and thus reduces the amount of manœuvring required), but also improves the homing range. Eventually a drawing of the complete missile could be prepared, and this appears as Fig. 4. Points of interest include the reduction in cross section of the body in line with the engines (a form of area rule), the cruciform of control surfaces at the tail and the use of a large tandem boost motor. Comparison with the present Bloodhound (Fig. 5) will show to what extent these areas have changed.

This configuration was initially investigated with the XTV-1 vehicle, a quarter-scale model boosted by a tandem package comprising three 5in motors. Firing trials produced valuable stability and drag information, but indicated that in the full-scale missile it was going to be all but impossible to obtain adequate structural strength and stiffness at the joint between the boost package and the missile. Accordingly the boosts were divided into two clusters, disposed alongside the rear body and pin-jointed to each other at the rear. As the drag on the boosts overcame their thrust at burn-out, the complete package was arranged to slide away to the rear and open about the pin-joint. Such an arrangement was flown for the first time on the XTV-2 (Fig. 6), a one-third scale model incorporating full control and employed in the investigation of roll and pitch behaviour. Succeeding test vehicles were the XTV-3 (Fig. 7), a full-scale device but without ramjet power, and the XTV-4 in which were incorporated the full-size 16in ramjets described presently. The ultimate test configuration was the XTV-5, which closely resembles the present Bloodhound and incorporated a homing head. It will be noted that in XTV-5 a single horizontal tailplane was employed, and this permitted the introduction of a much more compact arrangement of aft-mounted boost motors. First incorporated in an XTV-3, this configuration involves four boosts all hinged to a common ring at their rear ends, and separating from the missile as a unit.

Reverting to the problem of propulsion, it early became evident that the final missile would require twin engines with a diameter of around 16in. A 16in-diameter engine was designed in Seattle by a joint Bristol/Boeing team, and appropriately designated BB.1. Within nine weeks of the release of the drawings to the shops at Filton, the first unit had been manufactured, shipped to America and there run on the bench to full thrust. Wingless test vehicles were next employed and, when suitable modifications had been made to the intakes and combustion system, a large number of rounds were successfully flown up to about 30,000ft (when rich extinctions occurred).

Since ground facilities were severely limited, extensive flight testing was necessary in order to achieve reliable light-up and good combustion. In the course of development of the production ramjet virtually every feature was redesigned, sometimes more than once; but the early flight trials of XTV-4 and XTV-5 were instrumental in laying a foundation for the final Thor engine. After a great deal of development an automatic, infinitely variable fuel control system was evolved in order to match the fuel/air ratio to the wide range of conditions encountered during the course of a mission. Bristol Siddeley Engines are justifiably proud of the tremendous standard of reliability and efficiency which is now being achieved by the production Thor. Further details of the production engine are contained in the description of the missile itself.

Unfortunately, permission has never yet been granted to publish

Fig. 7. An XTV-3 on its launcher at Aberporth

BLOODHOUND . . .

detailed chronological history of the development of a British weapon. Nevertheless it is logical to suppose that devices essentially similar to the present Bloodhound were being fired by the end of 1953. The first such vehicles were the XTV-4s, and their launchings from the R.A.E. Aberporth marked the entry of Bloodhound to the flight-test stage. Numerous structural and aeroelastic difficulties were encountered, but after some six months the XTV-5, almost representative of the final missile, began to fly using ramjet power and a complete control system. After further development XTV-5s undertook guided flight, under complete manœuvre control and with a homing head engineered to the full weapon standard.

During the past three years a large number of flight trials of the complete missile have taken place, using the operational launcher and associated with the ground target-illuminating radar. Both at Aberporth and Woomera numerous kills have been effected upon such high-performance targets as the Meteor and Jindivik, and the overall performance of the entire system has been brought to a very high standard indeed. Proving and evaluation trials have for many months been conducted by the Royal Air Force at the first SAGW station at North Coates, Lincolnshire (*Flight*, November 7, 1958). Although at present principally concerned with indoctrination training, North Coates could become fully operational at short notice. The total number of firings in the course of Bloodhound's development is now well over 500, and it is doubtful if any weapon system with the same degree of lethality against manned aircraft has reached a comparable state of readiness.

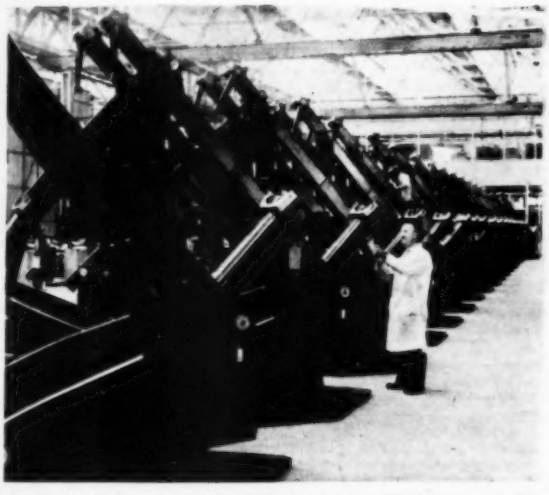


Fig. 9. Final inspection of launchers in the Cardiff factory of Bristol Aircraft. Each fires the missile at 45 deg elevation

THE BLOODHOUND SYSTEM

In the foregoing, emphasis has been laid on the fact that a surface-to-air missile system is a large and complex assemblage of ground units all designed to support and direct a single flying vehicle. Moreover, the entire concept has to form an operational unit, which can be integrated with a variety of control and reporting systems, such as that which covers the United Kingdom. Ignoring for the moment the administrative family tree, the components of the Bloodhound system can be listed as follows: Bloodhound missile; EW, early-warning radar; TCR, tactical-control radar; TIR, target-illuminating radar; LPA, launcher and launcher-plant assembly; LCP, launch control post; and Workshop.

Each of these can now be described in turn. In many cases, for reasons of security, full information cannot be given.

The Missile From the outline of Bloodhound's development it can be deduced that from the viewpoints of aerodynamics and stability and control, the vehicle has an unusual (and possibly unique) configuration. It is unfortunate that major details of the structure and systems remain classified, but much can be learned from a study of the large cutaway drawing on pages 432-433. Essentially the missile when launched consists of the following major portions: forebody; main body; wings; tailplanes; ramjet engines; and boost motors. Each of these may now be discussed in turn.

Forebody This comprises a cylindrical guidance bay with a light-alloy skin, ahead of which is a large radome which has an ogival form, terminating in a pointed nose. The fore and aft limits of the guidance bay are formed by a strong casting, which supports the receiver aerial dish, and a pressure bulkhead, respectively. Both are precision castings in magnesium alloy and they are joined together at their circumference by three equally spaced longerons of top-hat section.

Within the guidance bay is an inner structure upon which are mounted the packages which comprise the guidance system. The assembled outer structure is attached to the inner structure by means of external bolts which pass through lugs on the pressure bulkhead and screw into longitudinal lugs riveted to the rearward edge of the skin of the guidance

Fig. 8. A Sting-Ray TIR in service at North Coates. This radar is produced by B.T.H., one of the A.E.I. companies

bay. Around the forward edge of the guidance bay is riveted an adaptor ring to which the radome is secured by countersunk screws. On the inner side of the ring are keys which engage with slots around the dish-support castings in order to locate the latter and the forward end of the inner structure.

Details of the construction of the radome may not be divulged, but, like all such mouldings, it must have very considerable structural strength in order to resist extreme aerodynamic loads during manœuvring flight, must be capable of resisting the shattering impact and erosion of flight through rain or hail at more than twice the speed of sound yet must cause minimum interference and distortion to the incoming radiation upon which the missile homes.

Main Body Under this heading are grouped all body sections aft of the forebody. Conventional aeroplane monocoque construction is employed throughout, heavy frames cast in magnesium alloy being joined by light-alloy longerons upon which are riveted and bolted the light-alloy skins. The heaviest loads in the entire missile are those generated by the wing during manœuvring flight. They are transmitted through the rotary hubs into the main-frame casting, which also has upper and lower mounting brackets to which are pinned the forward ends of the engines. Around the outside of the body, in line with the main-frame, are bolted the forward anchorages of the four boost motors. At the extreme rear of the body is a tail-block casting, through which pass the inputs to the missile while the latter is on its launcher. Around this casting are the tailplane-attachment points and the rear supports for the ramjet engines.

The forward end of the main body is occupied by the warhead bay, to the rear of which is tankage. Kerosine fuel is used, contained within a flexible rubber bag which is externally pressurized by ram air from the stub-wing intakes to assist the feed to the turbopumps. To the rear the body is tightly packed with such units as the auxiliary power unit, the Mach control and the high-pressure hydraulic accumulators, the majority of these units being located on a shock-proof mounting bolted to the longeron assemblies. Access to the interior of much of the main-body may be gained through stressed skin panels retained by countersunk screws.

Wings Each wing has acute taper to a tip cut back at what may well be the Mach angle. The cross-section is trapezoidal. The basis of each wing is a wooden matrix to which are bolted front and rear root ribs and the heavy light-alloy spigot which locates the wing in its hub in the main-frame casting. The leading edge is a strip of magnesium alloy to which are attached the upper and lower front skins. The latter are also secured by flush rivets which pass through the upper skin and the matrix and into the lower skin. Similar attachments retain the upper and lower rear skins, which are riveted together at the trailing edge. All skins are of heavy-gauge light-alloy and are buffed smooth and painted. Finally the wing spigot is "dogged" into the hub, where it is retained by spring-loaded pins.

Tailplanes In configuration these surfaces differ from the wings in that they are untapered and have a parallel double-wedge section. Each tailplane has a constant chord and is constructed in a manner similar to the wings.

Engines Security forbids disclosure of internal details of the version of the Bristol Siddeley Thor which provides cruise propulsion for the production Bloodhound. Nevertheless it is possible to describe the closely related Thor BT.1, and this is the powerplant which our artist has depicted in the cutaway drawing.

Like most such units, light-up is achieved only at supersonic speed at the end of the boost phase. During the boost phase the missile is very rapidly accelerated and ram air enters the intakes of the engines and the auxiliary stub-wing intakes which feed the ram-air turbines and pressurize the tankage. The latter spin up within a second or two and feed kerosine fuel at high pressure to the injection nozzles within the engines. Ignition is accomplished by strontium flares which are fired electrically during the launching sequence. As the cutaway drawing shows, the control system is housed within the island; the main fuel-feed passes through the fuel/air ratio control immediately behind the shock cone (to which ram-pressure signals are passed from the pressure head of the pitot intake) and thence is ducted, via the feed elbow, through the check valve and finally rearwards to the injection nozzles.

Ram air enters the Thor through a double-shock intake and is decelerated through the diffuser passage between the island and the engine body. A small proportion of the flow enters the pilot intakes to provide the pilot flame at light-up and this flame spreads to the main fuel flow streaming from the 12 injection nozzles. Almost at once the stabilized condition is reached with the fuel burning behind the annular V-gutter flameholder. From the pilot intakes the ram air is turned sharply inwards to pass through a ring of guide vanes which engender

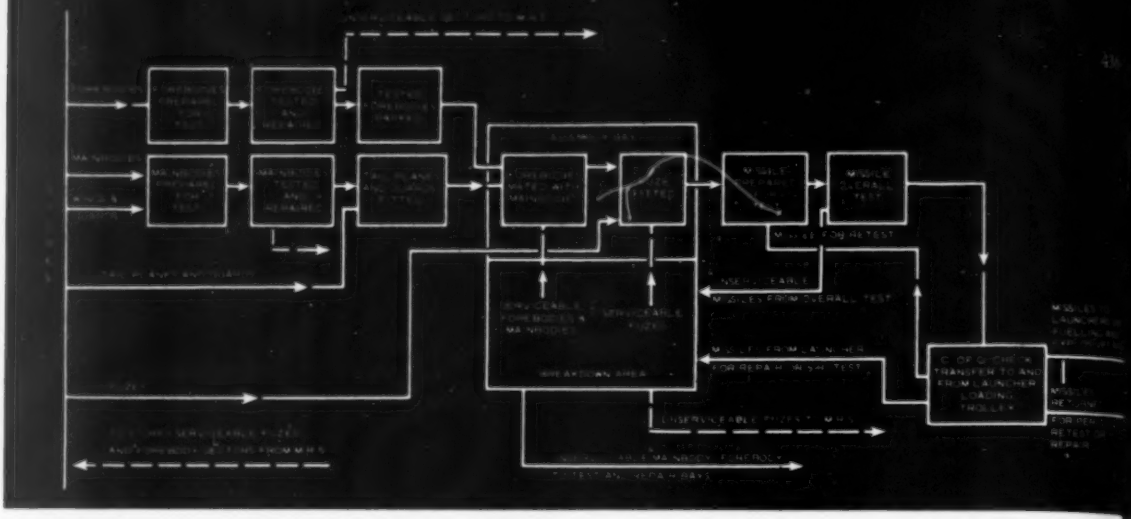


Fig. 10. This diagram traces the course of the various portions which make up the complete missile as they pass through the workshop upon receipt and again for repair following failure of a check on a launcher. An interior of part of such a facility is depicted opposite

BLOODHOUND . . .

swirl and stabilize combustion of the pilot flame at the downstream end of the island. Farther aft the main combustion space is surrounded by a perforated liner, which reduces vibration and greatly increases the fatigue life of the engine body.

Finally, the gases accelerate through the propulsive nozzle, within which is a liner giving a convergent/divergent inner profile. Peripheral holes admit air to cool the nozzle and reduce heat transfer through the aft anchorage. The latter permits axial thermal expansion to take place between the ramjet and the missile mainbody; the front mounting bracket is rigid, and adjacent to it are situated the fuel connections. It may be noted that, although the engines are not mounted on the wing tips as in the original configuration (Fig. 4), they are nevertheless carried well away above and below the body in order to provide satisfactory airflow to the intake and prevent excessive heat transfer to the rear of the mainbody and the tailplane.

Brief reference has already been made to the engine control system. The most important portion of this system is the FARC (fuel/air ratio control), which governs the fuel supply to the injector nozzles according to the demands of the airflow. In order to increase flight acceleration from ramjet light-up to cruising speed, the FARC is designed to give maximum thrust during the early stages of ramjet flight. Once normal operating speed is reached an override weakens the fuel/air ratio to the minimum strength concomitant with design performance in order to extend the effective range. By such means the ability of the missile to effect interception on distant targets taking evasive action is much enhanced.

Boost Motors Boost propulsion of Bloodhound is provided by four large boosts, the cases of which are manufactured by Bristol-Aerojet. Each contains a solid charge in a thin-walled canister, capable of resisting the high combustion pressure. Ignition is effected electrically and the propulsive jet issues from a convergent/divergent nozzle which is canted outwards—doubtless so that the thrust-lines from the four motors may pass through the c.g. of the missile, and thus minimize pitch or yaw consequent upon failure of one boost. At the rear end of each motor is a heavy annular ring carrying lugs which are pinned to a thrust yoke which links the rear ends of the four motors, and during the boost phase rides on the rear end of the missile and transmits the boost thrust via a stepped diameter which abuts on the rear face of the missile main body. The nose of each motor carries a conical cap and a pair of small canted vanes which, towards the end of the boost phase, generate a radial lift force which tends to pull the forward end of the motor away from the missile.

At boost burn-out the combined thrust of the four motors falls below their aerodynamic drag. When this occurs the four boosts slide rearwards as a unit until their forward anchorages become unlocked. This permits the forward ends of the motors to part company with the missile body so that the boosts petal outward about their aft hinges. The missile, under the thrust of its recently lit ramjet engines, accelerates away from the boost system which suffers a free fall and is regarded as expendible. The motor casings are welded from steel sheet, and the front hook (which also includes the lock which engages with the forward support arms of the launcher), the integral nozzle and the thrust yoke are all forged in aluminium alloy.

EW, Early-Warning Radar Owing to the fact that early-warning systems feed vast tracts of territory with advanced information of an impending attack they are not normally associated with any particular weapon system. The Bloodhound can be integrated with any standard EW radar.

TCR, Tactical-control Radar The function of this, the largest indivisible piece of the entire weapon system, is to provide the volumetric (i.e., three-dimensional) picture of the overall battle situation. Produced by Metropolitan-Vickers, the radar itself includes the rotating transmitter aerial some 50ft in width, and an electronic lens through which the return signal is funnelled and reflected into eleven receiver horns. The data thus obtained is then automatically processed and stored. By this means the position of each individual target, together with other relevant information about it, is fed into the store and then kept continuously up-to-date by one of a group of weapon-control teams. At an appropriate moment, data may be switched by a target-selection officer in the TCR to the Fire Unit(s), as outlined below. Each FU normally appears to be divided into two flights, each comprising eight launchers linked to a TIR.

TIR, Target-illuminating Radar As already noted, the missile homes on to the radiation reflected by a target while the latter is "illuminated" in a pencil-beam of microwave energy from a radar on the ground. The latter is the TIR. Data from the TCR may be fed into the TIR in order to turn the aerial of the latter to acquire the target at the earliest possible moment. When the TIR is brought into action it illuminates the target, providing the source of radiation upon which the homing head in the missile can subsequently lock-on. Tracking of the target follows automatically, and a continuous supply of target-position information is fed to the associated launchers (perhaps eight) up to the point of firing.

Known as Sting-Ray, the TIR is produced by B.T.H. and may be employed in the static or mobile rôles (Fig. 8). As noted above, one TIR is allocated to each flight of an FU. Each TIR may be tuned to match the receiver circuit in a particular Bloodhound, in order to ensure that the right radar always maintains control of a particular missile and to increase resistance to countermeasures.

Essentially, the TIR installation comprises an aerial vehicle and a display vehicle. The former consists of a trailer-mounted base frame upon which is erected a heat-insulated cabin, a turntable and an aerial mount. Supported rigidly on the base frame, the azimuth turntable carries a trunnion structure supporting the elevating cradle which in turn locates the microwave feeders and the dish-type reflector. Dual servo motors drive the aerial in azimuth and elevation. The complete vehicle incorporates the usual jacking and levelling gear, ladders and cat-walks. Also thermally insulated, the display vehicle is divided internally into compartments for equipment and for the operator. In the former are sections of rig-mounted equipment, each section usually being assigned to a specific function, such as alignment or power; each unit is of standard building-block type, thus eliminating flexible cable connectors. The operator is seated in front of the controls and monitoring equipment necessary to govern the acquisition of a target and subsequent lock-on. He has before him a panel of buttons by which the TIR is controlled, together with lamp-order signals for command communication with other portions of the weapon system.

Launcher and LPA, Launcher-plant Assembly When ready for firing, the missile is supported on a zero-length launcher with an elevation of 45 deg. The launcher trains the missile in azimuth to point towards its selected target and also provides for all the service connections needed by the missile prior to the launching.

As shown in Fig. 9, the launcher is of robust construction, being fabricated almost entirely in steel. In most R.A.F. installations the launcher base is permanently bolted to concrete. Upon this foundation is mounted a rotating base driven by a servo motor in response to signals received first from the TCR and finally from the TIR. Upon this base is pivoted the launcher beam, which is positioned horizontally while the missile is being loaded on to the launcher and is then raised by a hydraulic jack to the 45 deg elevation. The Bloodhound is carried on the beam by transverse pins on the underside of the forward end of each of the two lower boost motors, which ride on the upper ends of the swinging links pivoted to the upper ends of the launcher beam. The third suspension point is provided by a multi-pin socket on the underside of the missile main-body, which rests upon the mating connector block carried at the upper end of a swinging arm towards the lower end of the launcher beam; this connection is automatically broken during the launching.

Adjacent to each launcher is the LPA, which consists of a blastproof structure housing hydraulic, cooling and electronic supplies. Hydraulic power, both to the launcher and missile, is taken through flexible pipes from the LPA, the feed to the missile being routed through the launcher to the static section of the co-axial coupling in the rear bracket. Cooling air is piped to the LPA from remote compressors, refrigerated and piped to the missile through the co-axial coupling. Cables through the LPA also feed the electric motors for launcher slewing, driving the electric

motor/pump unit which supplies hydraulic power to the launcher, the ramjet and boost igniting circuits, the electronic controls and the monitoring services.

LCP, Launch Control Post As the operational nerve centre, the LCP prepares and launches the missiles either singly or in salvoes against their allocated targets. To minimize delay, automatic equipment is employed wherever possible. Functioning of the LCP is described in more detail in the concluding section of this account in which the system is examined as a whole.

Workshop Bloodhounds are delivered dismantled, each major section being carefully packaged to reduce transit damage and deterioration due to storage in adverse climates. A workshop assembly and servicing section is therefore required to test the individual sections, assemble them and then test the complete missile. Moreover, missiles may develop faults while they are on the launchers, and in order to maintain a Fire Unit at the highest state of readiness a feed-back of faulty rounds from the launchers must be made good by a steady flow of repaired missiles. This is depicted graphically in Fig. 10, which also shows in schematic form the sequence of operations involved in preparing a newly received round. In order to minimize the ingress of dust, the entire assembly and servicing hangar is slightly pressurized.

Ground-handling Equipment Even such mundane tasks as transportation, handling, servicing, assembly and preparation for launching are vital functions, requiring, in every case, special apparatus designed to suit the special needs of each weapon. Owing to their experience in this field M.L. Aviation undertook the design, development and production of the complete Bloodhound handling equipment.

Type 12 Air Cooling and Drying Unit This highly compact, self-contained refrigeration unit has been designed to provide automatically a constant supply of extremely dry, cool air to the interior of the missile during ground testing. It operates from the electrical mains.

Launcher-loading Trolley As its name implies, this is designed, in the first place, for the transportation from the assembly shed to the launching site and for loading the complete missile on the launcher by means of the retractable parallel-motion arms supporting the cradle. Additionally, it provides an effective stand for fuelling and the fitting of boosts and warhead.

Boost Motor and Explosives Trolley A towable trolley for transporting two boost motor assemblies and the explosive warhead system.

Repair Stand A four-wheeled, manually propelled stand supports the mainbody of the missile during repair and test. By retracting the central supporting frame the mainbody can be rotated to any desired angle of roll, and secured by application of the front band brake and rear retaining strap.

Mainbody and Assembled Missile Stand This consists of a lower wheeled chassis equipped with parking brakes, and a superstructure which can be traversed and yawed by chain-driven screws. Four independent jacks provide adjustment in height and pitch, and the front crutch support is rotatable about the roll axis.

Forebody Stand and Jib The jib is for lifting the forebody out of its transportation case. The longitudinal rails, positioned to line up with the rails in the case, are fitted with stops to prevent the forebody skip overrunning. The forebody stand itself consists of a chassis on which is mounted a semi-circular cradle. The latter pivots on kingpins to allow adjustments to be made when offering the forebody to the mainbody.

Air Transportation Stand Provided for carrying the missile in a freight aircraft, it has a tubular steel chassis with a set of jacks to facilitate its rigid stowage. The missile supporting structure, fitted with two cradles and a rear frame, is mounted on four clusters of anti-vibration mountings.

Accessory Equipment In addition, M.L. Aviation provide a complete range of accessory equipment, such as lifting slings and beams, for each component assembly and the complete missile.

It is appropriate now to describe the functioning of the overall system by relating how a particular target is engaged.

THE SYSTEM IN OPERATION

As depicted in Fig. 10, newly received rounds are assembled and tested in a routine and largely automatic manner. As far as possible test equipment indicates no more than a pass or a failure on a "yes/no" basis. Items rejected as being defective are repaired by replacement, initially of main assemblies and then of sub-assemblies. The capability of the equipment and the skill of the personnel involved naturally increases with the depth of diagnosis of the fault. After successfully passing all tests—the final check is a c.g. determination on the completely assembled round—the Bloodhound is mounted on its servicing trolley for arming, fuelling and boosting. It is then ready for loading on to its launcher.

After the missile has completed a specified period of readiness on a launcher it is recommended that it be checked for serviceability. In a matter of minutes it may be removed on to the launcher-loading trolley, and, after de-arming and defuelling, towed round to the workshop handling system and tested at the overall test bay. Failure results in the usual repair-by-replacement, while a serviceable missile is returned either to the ready-use store or to a launcher. Other portions of the Bloodhound system are serviced and maintained *in situ*.

An incoming raid is first discerned by the EW radar, one of which is allocated to each SAGW wing. The overall EW system is semi-automatic and follows precepts first revealed at an Open Day at the R.R.E., described in *Flight* for May 2 last year. Operation of the succeeding electronic portions of the Bloodhound system were described as follows in our issue of November 7, 1958:—

"In the operations room operators sit at rows of P.P.I. consoles on a sloping stage, looking towards an entirely electronic tote-board on which all relevant "blow by blow" information on targets and missiles is displayed. In charge of the whole group is a controller who has before him a television picture of the radar presentation transmitted from the early-warning centre by micro-wave link. Below this he has the picture produced by his own tactical radar. The controller is supported by a supervisor looking after the radar side of the control room and by an assistant controller taking care of detailed procedures and communications. On his tactical scope the controller can place a marker ring by joystick control and cause this ring to be reproduced on the tactical scope in front of a track allocator. Equipment of this type, produced by Marconi, was described in *Flight* for October 10, 1958.

"The allocator also has the early-warning picture repeated to him. His main function is to steer his own ring, again by means of a joystick, over the selected target; to track the target for a while; to identify it as hostile or friendly (though this may well be done much farther up); to give it a number and other tags; and to inject it initially into the main data-store. At the same time his findings are presented on the tote board as coloured numerals and letters.

"The store itself records voltages indicating all relevant information on a particular target and the reference number of each batch of information is passed to one of a number of weapon-control teams, each consisting of a target selection officer, two trackers and a height operator. The T.S.O., a key man, selects one of his trackers to follow the target with his own joystick-controlled marker and keep the store up to date while the height operator adds height information derived from the tactical radar. It is the T.S.O.'s task to decide when a particular target can be engaged by the sites under his control and then to feed the relevant information from store to the Sting-Ray target-illuminating radar. Sting Ray then aligns itself to gather the target into its pencil beam, lock-on and follow it automatically; the selected launcher follows its azimuth movements. When this is done the target-selection officer orders Bloodhound to be fired. He can alternatively interrupt the whole tracking and command process and destroy his missile in flight."

It is fundamental to the guidance system that the receiver dish in the nose of the Bloodhound is locked-on to its target while the missile is still on its launcher. From the incoming radar signal reflected from the target, the missile receiver extracts the yaw and pitch components which enable the airborne guidance system to keep the dish pointed at the target, and also moves the wings in order to effect an interception course. At the moment of launching the missile is pointing directly towards the target in azimuth at an elevation angle of 45 deg. When the firing circuit is energized the four boosts are fired, all ground connections are broken and the missile accelerates very rapidly up to boost burn-out. Internal power supplies, initially fed from the LPA on the ground, are served during the boost phase by gas pressure and subsequently by the turbines driven by ram air from the stub-wing intakes. Ramjet light-up has already been described.

Like most surface-to-air weapons Bloodhound follows a proportional navigational course, i.e., the rate of turn of the missile is proportional to the rate of change of the bearing of the target as seen by the receiver dish. Thus, although the dish always remains locked-on to its target, the axis of the missile remains aligned with an interception point some distance ahead of the target. Throughout the flight the airborne guidance computer takes into account such variables as missile altitude, target course and speed and variation in the reflected signal from the target. A conventional gyro is employed as a space reference to determine dish position. Error signals, proportional to the difference between gyro and dish orientation, are used to operate hydraulic valves which control a pair of double-acting jacks which position the dish in pitch and yaw. At the same time more powerful hydraulic servos are energized in order to position the wings to steer the missile. The required pitch and yaw components are compared in order to obtain a roll signal, and the resulting pitch signal is passed to the wing servos only when the missile is rolled to the required attitude. A feedback circuit ensures that, in the absence of any guidance demand, the missile remains roll rate stabilized.

In order to prevent arcing at the great heights reached by Bloodhound, the guidance bay is sealed and pressurized. The bay itself is divided into three 120-deg segments which respectively house the guidance electronics, the control electronics and the main alternator, driven by hydraulic oil. All electronic assemblies are of the plug-in, building-block type, and printed circuitry is extensively employed. The warhead naturally remains shrouded by security, but it seems fair to assume that it must be an exceedingly large h.e. type employing well-proven and standard techniques. (During development firing the warhead is normally replaced by a telemetry sender and a self-destruction charge to prevent the missile from going beyond the limits of the range.) Final detonation of the warhead is accomplished by a proximity fuse.

In conclusion, it is appropriate to remind readers that Bloodhound Mk 1 has been purchased by the Royal Swedish Air Board after an extensive evaluation against competing systems, and that initial deliveries of equipment against this contract have already been made. Moreover, an advanced Mk 2 version of Bloodhound is now in a late stage of development and promises to offer "greater lethality at increased range and altitude, as well as improved performance against low-flying targets."

Fig. 11. Taken at North Coates, home of 264 Air Defence Missile Squadron, this "Flight" picture shows a serviceable Bloodhound being lowered on to its M.L. Aviation launcher-loading trolley

Straight and Level

EXEUNT Beswick and Mikardo. These two Labour ex-M.P.s lost their seats in the recent election. I do not think that even the most die-hard Tory in the aviation business can fail to feel a twinge of regret. Whenever aviation was debated in the House you could always rely on Frank Beswick or Ian Mikardo to provide the brightest and most explosive opposition fireworks. Their absence will inevitably diminish the quality of aviation debates. Indeed, unless equally worthy adversaries arise from the new opposition benches, many are the administrative aberrations which may, in the absence of these two early-warning *vigilantes*, pass unchallenged.

Frank Beswick was (the past tense refers to his status as an M.P.) exceedingly well informed, and he was temperate. The number of questions he raised that went unanswered or were sidestepped cannot be counted. Ian Mikardo was not quite so temperate. But his command of the English language was brilliant, and I could not count the number of times his barbs caused Hon. Members to cry: Oh!

I am sorry that these two have passed from the Parliamentary scene, because—whatever one's political views—it is indisputable that good opposition means good government.

● In a recent leading article, Clarke Newlon, editor of our transatlantic contemporary *Missiles and Rockets*, says, "The aerospace industry is the biggest manufacturing industry in the world (753,500 employees against 741,900 for automobile at last count) and its members must learn that it's a tough world with very tough competition for the breaks . . ."

Truly these are words of wisdom. The American industry has been sustained at this mighty level only by the artificial forces created by the so-called cold war. If peace on Earth ever becomes the accepted way of life, more than half the 753,500 are in for a thin time.

I will stick my neck right out and predict that, within five years, 75 per cent of the aircraft industry work-forces in the U.S.A. and the U.K. will be making equipment for civil aviation.

● Before I open my mail each morning I can guarantee that 50 letters out of every 100 will refer to a note which appeared in this column nearly a year ago now, on December 12, 1958. It was about the Meeting Simulator, designed by Sir Harold Digit-Smith's firm Thinx Electronics Ltd. Here is one of these letters, received last week:—

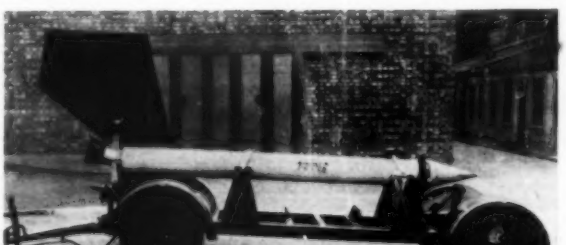
"My Dear Bacon,

We in the Super Scruggsdyne Grouponics will always be grateful to you for drawing our attention to the Meeting Simulator. You have no idea how our production has leapt and our costs have fallen since we bought and installed our NEDDY, as we affectionately call him. The savings alone in coffee expenses, jacket-elbow repairs and green-baize table cloths has been quite astonishing.

"But the most fantastic thing is that not only are our own key people on the job all the time, and available when they are needed, but NEDDY has completely banished what I call the 'let's-have-a-meeting' philosophy of business management. NEDDY is now used almost entirely for programming the directors' football pools.

The best of British luck to you,

[Signed] J. Blackout-Jones,
Chairman and Managing Director."
[Advert.]



Now revealed in Straight and Level's entry for last summer's *Daily Mail* air race. To be driven by myself, it was expected to attain 630 m.p.h. along the new Cromwell Road extension. At the last moment, however, Bristol could not spare this vital Bloodhound component and besides, I found I had another urgent engagement

● "We must face up to the issue that if we are going to remain in the forefront of world technology we have got to spend a good deal of money in a limited field and make a success of it. I think we could face the world so long as we have good thinking ahead, so long as we limit the field, and decide to spend money to make it a success. . . . How limited the field should be is the biggest policy issue of the lot."—Mr. Peter Masefield, managing director of Bristol Aircraft, on the B.B.C.

● Earlier this week Britain's air traffic control officers got a pay-rise. So I thought that this extract from the *Journal of Air Traffic Control* by Mr. Charles Kite, a controller at Denver and a qualified pilot, would interest you:—

"Controllers never mention it, or discuss it, but they are all aware of that silent, little understood barrier to the faint of heart. With 15 airplanes approaching from all directions, and voices calling constantly on the speakers, it is easy to get the feeling that you are surrounded by an utterly impossible situation. Air traffic control can consume a new man quickly and efficiently, making him half afraid of himself. . . . It is not surprising that, with the rise in traffic count, the toll among controllers becomes higher each year.

"Early in the game, a controller must develop resistance to expediting beyond the bounds of safety and reason. This is a perpetual trap awaiting the student as he masters the fundamentals and becomes confident of his ability. Sometimes resistance develops rapidly, after he has scared the wits out of himself, raised a few eyebrows in the pattern, and brought several fellow controllers in the tower to their feet . . ."

● Conversations with the pilots on our staff makes me anxious about the new motorways that are being built across the face of England.

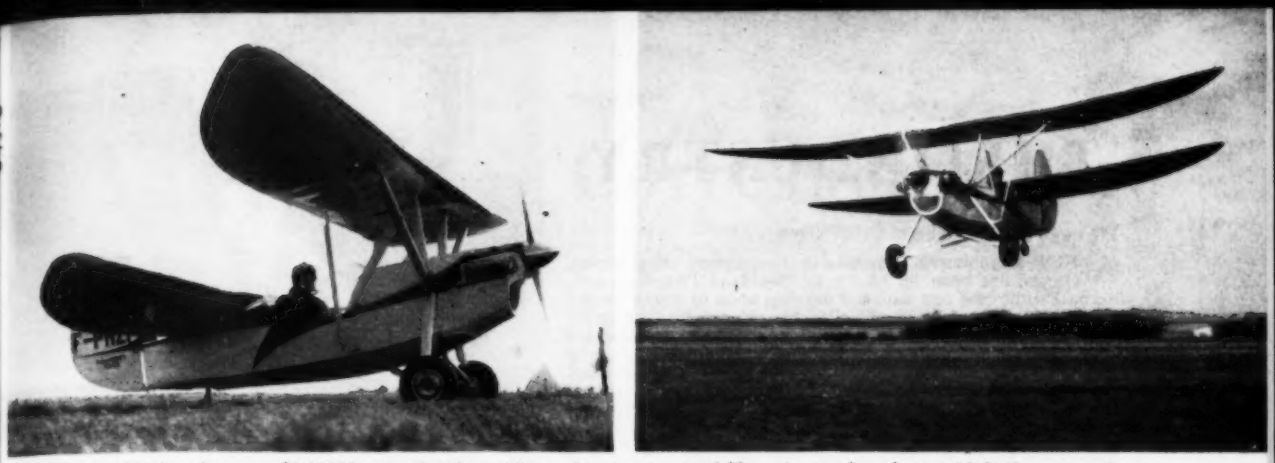
The former Ministry of Transport may have been well on the way to solving the road traffic problem, but I think I ought to warn the new Ministry of Aviation that there is going to be an unexpected *air* traffic problem to cope with as well.

Three times as wide, much straighter and more continuous than a double-track railway, the motorways are the best landmarks the private pilot has ever had. I predict that, especially when the weather clamps down, there is going to be a steady stream of air traffic Brads shawing up and down above them.

Private pilots in the south of England have been getting used to following rail-way lines by official decree ever since the West Malling restricted area came into force in the summer. How about the new Minister of Aviation, Mr. Duncan Sandys, establishing special private pilots' airways along the motor-ways, thus combining two transport functions in a way that his predecessor was rarely able to do?

● Have you noticed these technical reports which, having set out on a difficult, or even impossible, and, more often than not, thankless, task, on behalf of a customer—not of their own choosing—who may, if he were so inclined, take another, and much more simple (or, at any rate, less difficult) approach, have, at the earliest opportunity, incorporated as many as, if not more than, possible subsidiary clauses in every sentence?

ROGER BACON



Henri Mignet and his Porsche-powered HM-320 pictured at Caen. The machine incorporates folding wings, and can be towed behind a motorcycle

Sport and Business

ANNUAL GENERAL MEETING of the Kronfeld Club was held on Wednesday, October 14. In his report the secretary, Hugo Trotter, regretted the continued lack of interest in the club shown by light powered-flying enthusiasts, compared with the support displayed by the gliding fraternity. One place on the club committee remained vacant for a power-flying representative.

Forthcoming Kronfeld Club events include a painting exhibition and competition (November 2-11); annual dinner and dance (November 6 at the Eccleston Hotel, London, S.W.1); and Christmas party (in conjunction with British Women Pilots' Association on December 16).

NORFOLK AND NORWICH AERO CLUB is now operating again after a gap of 20 years. The club's two Tiger Moths, operated at 50s per hour, are based at Swanton Morley, and town headquarters at the Air Centre, 28 St. Giles, Norwich, have been opened. President and secretary of the club are respectively A. A. Rice, J.P., and H. Rushmer.

TWO WINTER COURSES of lectures at Fair Oaks Aero Club begin on Wednesday, November 4. The first covers P.P.L. subjects and the second is devoted to the Restricted Radio-telephony Licence. Up to the end of last month this year's flying hours at Fair Oaks totalled 4,688. Winners of the club navigation exercise for the Fair Oaks Cup were members Wein and Hall.

LOCKHEED AIRCRAFT CORPORATION has placed orders totalling about $1,000,000 with Collins Radio Co. for communications/navigation equipment for the JetStar executive aircraft. The first 25 machines will be completely equipped with Collins systems including the FD-105 integrated flight system.

SLINGSBY SAILPLANES LTD. in their current newsletter give details of the total number of aircraft produced at Kirby-Moorside since 1942. Excluding prototypes and experimental machines, the list is as follows: T.7 Cadet 1, 394; T.8 Cadet 2/Tutor, 81; T.21 Sedbergh, 223; T.25 Gull 4, 4; T.30 Prefect, 46; T.31 Tandem-Tutor, 181; T.34 Sky, 16; T.37 Skylark 1, 2; T.38 Grasshopper Primary, 97; T.41 Skylark 2, 58; T.42 Eagle, 16; T.43 Skylark 3, 30.

THE BELGIAN ROYAL AERO CLUB announced last month that the winner of the 1959 International Competition for the Victor Boin Challenge Trophy for gliding distance was David Ince. His winning flight was made in an Olympia 419 on July 5 from Charleroi to Münster, a distance of 289 km.

FIRST FULL ACCOUNT of the cross-channel glider flight made by S/L. J. Croshaw on June 7 is given by the squadron leader in the October issue of *Sailplane and Gliding*, the British Gliding Association magazine. After taking off from the R.A.F. Wessex club's base at Andover in a Skylark 3, he released from aerotow over Upavon with the object of heading for Hawkinge and, if sufficient height could be achieved between Folkestone and Dover, crossing the channel and trying for 500 km distance. From a height of 8,200ft near Folkestone the channel crossing was completed, the French coast being crossed between Cap Gris Nez and Calais. Failing to reach lift inland, he landed on the beach to the east of Gravelines.

Of equal interest to the flight itself was the return journey to this country. This was organized on June 8 with the help of Air Charter and the Automobile Association at Calais. Skylark and pilot were transported by truck from Gravelines to Calais, and by Air Charter Bristol Freighter from Calais to Southend.

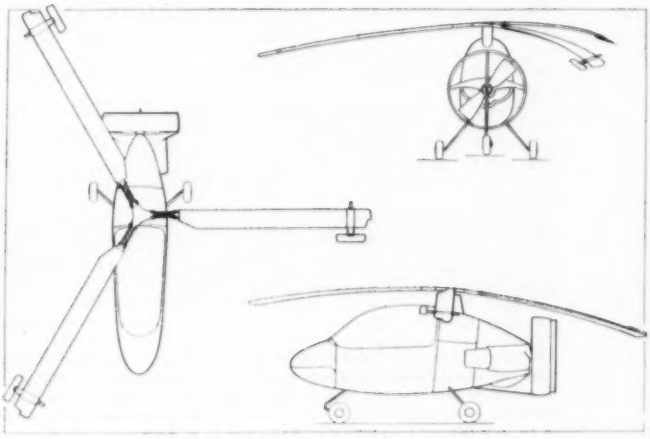
TWENTY-FIRST ANNIVERSARY of Surrey Gliding Club will be celebrated at a dinner at the Eccleston Hotel, London, S.W.1, on Friday, December 4. Ex-members of the club wishing to attend—particularly those who flew with the club from Redhill or Betchworth—are asked to contact Hugo Trotter, 56 Victoria Street, London, S.W.1. Tickets cost 25s each.

THE GLIDING RESEARCH ORGANIZATION OSTIV is seeking nominations for the award of the 1960 OSTIV Prize. This is a biennial presentation for the most important technical or scientific advancement in soaring flight, and the first winner (in 1958) was Dr. Joachim P. Küttner. Names and qualifications should be sent to OSTIV President L. A. de Lange, Kanaalweg 3, The Hague, by January next.

RETROSPECT

From "Flight" of October 23, 1909

Doncaster Meeting: Friday of last week, which had been announced as the opening day of the Doncaster meeting, provided little excitement, for although several machines had arrived no attempt was made to fly. All that was done in the way of a public performance was the running of the Cody machine along the ground and posing of the others before the camera, and this provided the only entertainment of the afternoon. Three Bleriot monoplanes were brought out to be photographed, and on lining up were joined by the Windham monoplane. Then the old standing joke about "smashing the camera" was reversed, as just at the moment when shutters clicked, Mr. Windham was gently precipitated to the ground, the main frame of his machine snapping about midway of its length. This little incident naturally provided a good deal of chaff, but it can hardly be said to have been in the interests of flight in Great Britain that such a performance should take place in public.



The Avian 2/180 gyroplane, first product of Avian Industries Ltd. of Georgetown, Ontario *(see letter on page 441)*

THE INDUSTRY

Developing Automatic Control

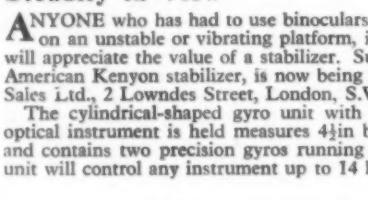
A NEW organization, known as the System Engineering Group, has been set up by de Havilland Propellers Ltd. Formed within the company and drawing upon its resources and experience in the missile, propeller and other fields, the group (with headquarters at Hatfield) has as its object the development of automatic control equipment which it is hoped will be useful to a wide range of industries. Use will be made of advanced electronic techniques developed by D.H. Propellers; digital systems will be used when possible; and most designs will incorporate transistors and ferrites.

The group's technical team will consist of Mr. R. J. Perdue, who has been with de Havilland for 15 years and is now chief designer; Mr. M. James, a member of the company for eight years; and Mr. R. A. Rubinstein, who came in a year ago when it was decided to expand activities outside the aircraft industry. In addition, a supporting staff of mechanical designers and electronic engineers is being assembled.

Steadily in View

ANYONE who has had to use binoculars, telescopes or cameras on an unstable or vibrating platform, i.e., an aircraft or boat, will appreciate the value of a stabilizer. Such an instrument, the American Kenyon stabilizer, is now being handled by Helicopter Sales Ltd., 2 Lowndes Street, London, S.W.1.

The cylindrical-shaped gyro unit with the aid of which the optical instrument is held measures 4½in by 2¼in, weighs 28 oz, and contains two precision gyros running at 21,000 r.p.m. This unit will control any instrument up to 14 lb weight, but two can



The Kenyon stabilizer and, at right, the nickel/cadmium battery which supplies the power for the gyros. In the centre is the charger

be used in tandem or in parallel. Power is obtained from a nickel/cadmium battery, from which a 6V inverter produces the required 115V 400 c/s current. It is stated that the battery, which can be recharged from a household circuit, will run the stabilizer continuously for 3 hr.

In operation the device appears most effective. High-power binoculars, for instance, can easily be kept trained on a small target in spite of irregular relative motion. Assistance of this kind should prove most useful for such purposes as air/sea rescue work; on high-speed motor boats; or by the captain of a tank or reconnaissance vehicle.

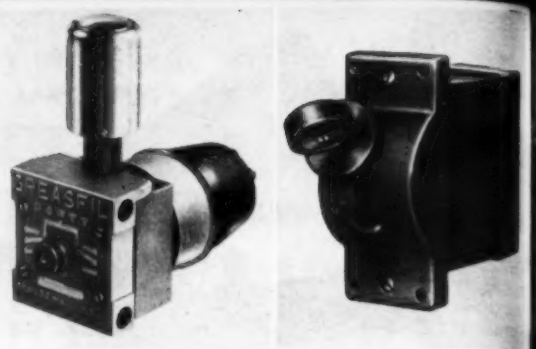
For Progress in Anodising

WITH the object of developing anodising techniques, an organization has been formed under the title of Anodising Research & Development Organisation Ltd. Responsible for the new venture are Technical Platings Ltd. of Teddington, Middx, Anodising & Platings Ltd. of Radcliffe, Lancs, and their associated companies.

Laboratory and research facilities are already available in the works of the two above-mentioned companies and their experience will, of course, be at the disposal of the new company, whose first directors are Messrs. W. A. Prestage and T. O. D. Craig, managing directors respectively of Anodising & Platings and Technical Platings.

Anodic oxidation of aluminium, as the anodising process was first called, was originally developed by the Royal Aircraft Establishment and became the subject of patents by Dr. G. D. Bengough and Mr. J. M. Stuart. The first general licence to operate the process was granted by the D.S.I.R. to Technical Platings Ltd. in 1931.

The one-twelfth-scale model of the D.H.121 seen on the right is the work of Mastermodels Ltd. of Greenhill Crescent, Harrow, Middx. Directors of this recently formed company—who also produce precision patterns, vacuum form-tools, and work in fibreglass and resins—are Messrs. N. C. Fisher and L. G. Barr



On the left is the new Dowty "Greasfil" switch, intended for a wide range of aircraft applications; designed to operate efficiently at any altitude, in all weathers and over a temperature range from +70 to −55 deg C, it is completely filled with a silicone compound which lubricates the action and provides hydraulic damping of shock loads. The heavy silver contacts "make" with a pressure of several pounds. On the right is a two-position lever switch (an alternative to the more usual push-button) for landing-gear selection. Both switches are products of Dowty Nucleonics Ltd., Andoversford, Glos.

IN BRIEF

The 100th order for Decca 424 series airfield control radar has been placed by Marshalls' Flying School Ltd., Cambridge.

Mr. R. C. McCormick, B.A., M.Sc., has joined Airtech Ltd. of Haddenham, Bucks, as chief electronics engineer. He has been executive engineer in Ultra Electric's Special Products Division and before that was with Mullard Research Laboratories.

Dr. Norman Loveless, a lecturer in psychology at Queen's College, Dundee, has been appointed a consultant to Smiths Aircraft Instruments Ltd. He is to advise on human responses to instrument information under high-speed conditions, a subject on which he has being conducting research for some time past.

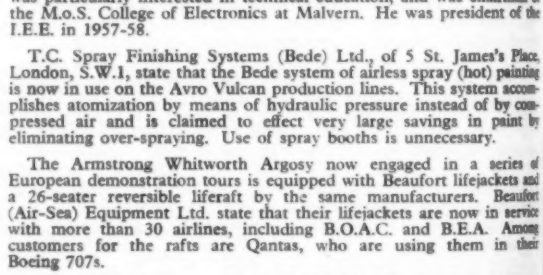
The Swiss company Ampex International S.A. announces that U.K. marketing of all Ampex magnetic-tape recorders for instrumentation and digital applications is the responsibility of a newly formed subsidiary, Redwood City Engineering Ltd., of Reading, Berks. At the head of the new company is Mr. V. Seale-Finch, who formerly specialized in Ampex products with Southern Instruments Ltd.

We regret to learn of the death, on October 6, of Mr. T. E. Goldup, C.B.E., M.I.E.E., a director of Mullard Ltd. Apart from his technical career—he was an expert in valve design and manufacture—Mr. Goldup was particularly interested in technical education, and was chairman of the M.o.S. College of Electronics at Malvern. He was president of the I.E.E. in 1957-58.

T.C. Spray Finishing Systems (Bede) Ltd., of 5 St. James's Place, London, S.W.1, state that the Bede system of airless spray (hot) painting is now in use on the Avro Vulcan production lines. This system accomplishes atomization by means of hydraulic pressure instead of by compressed air and is claimed to effect very large savings in paint by eliminating over-spraying. Use of spray booths is unnecessary.

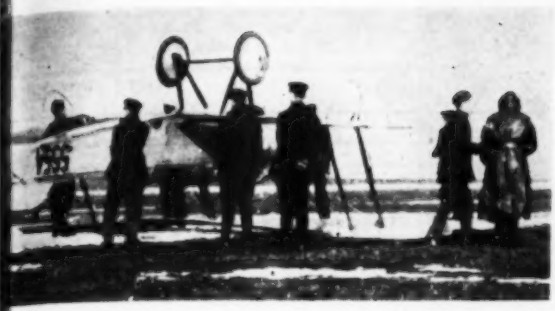
The Armstrong Whitworth Argosy now engaged in a series of European demonstration tours is equipped with Beaufort lifejackets and a 26-seater reversible liferaft by the same manufacturers. Beaufort (Air-Sea) Equipment Ltd. state that their lifejackets are now in service with more than 30 airlines, including B.O.A.C. and B.E.A. Among customers for the rafts are Qantas, who are using them in their Boeing 707s.

For the flight-deck scenes in the British Lion film *Jet Storm*, now on general release, Airlite headsets and combined S.P. oxygen masks were supplied by Airmed Ltd., of Harlow, Essex, and during the emergency-decompression sequence the toggle-operated masks are seen in operation. Airmed state that similar equipment is in current use in a number of jet airliners, including the Comet 4, Boeing 707 and Caravelle.



Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.



Capt. Albert Ball walks away from a nose-over by his Bristol Scout "C" (see letter below from Mr. Bruce Robertson)

No. 56 Squadron's S.E.5s

FOLLOWING the letter from Mr. R. Clive Gallop (October 2), would you please allow me to say a little piece about the original history of 56 Squadron and the S.E.5?

In June 1916 I was the N.C.O. i/c 56 Nucleus Flight, which was drawn from No. 5 R.A.S., Castle Bromwich, and later attached to No. 28 Squadron, Gosport, until the formation of the squadron at London Colney in August 1916. I remained with the squadron until it was disbanded at Narborough in February 1919.

The first delivery of S.E.5s to 56 Sqn. at London Colney from Farnborough had the greenhouse fitted. Then, as now, speed was the order of the day; and the squadron pilots, led by Capt. Ball, had the idea that by removal of the greenhouse, fairing-in the top fuselage, and fitting the Avro windscreen and headfairing, greater speed would result. Farnborough disapproved, and I think subsequent tests carried out by them showed no appreciable difference in performance.

It would be rather interesting if the present Farnborough team could repeat these tests on their S.E.5 with and without the alterations, to see if any advantage was gained.

Capt. Ball's machine was used as a pattern for the alterations to the other eleven S.E.5s, and this work was carried out by the squadron mechanics at Le Vert Galland, France, prior to the squadron becoming operational.

Comment by J. M. Bruce [in the footnote to the letter] about the wheel markings suggests that these must be the flight colours which we painted on the fabric wheel-shields, "A" Flight red, "B" Flight blue and white (segmented), and "C" Flight blue. This, incidentally, was the only colour adornment allowed by the C.O., Maj. Blomfield.

I also have some remembrance of the centre section trailing-edge being cut back to give the pilot better upward view.

Boscombe Down, Wilts. E. VOUSDEN.

THE "new" photograph of Captain Albert Ball's S.E.5A A4850 (*Flight*, October 2) interested me considerably as I have a fairly comprehensive record of that particular machine. It was delivered crated from the Royal Aircraft Factory to London Colney, where it was assembled, on March 15, 1917. The large enclosed type of cockpit cover was replaced by an Avro-type windscreen and the resultant gap in the fuselage decking was faired in with plywood. At the same time the external top-wing gravity tank was removed and instead a tank was fitted into the wing centre-section. Standard "factory" wheels of B.E.2c type were replaced by Bristol-type. A different type of seat was fitted and the tailplane controls were altered. Strangely, the Vickers gun and C.C. gear were removed and a Lewis gun was fitted to fire through the bottom of the fuselage; but after the machine had been flown to France the Lewis was removed and a Vickers refitted. A further change in France was the fitting of Spad-type exhausts to the engine.

Ball's first victory with A4850 was on April 23, 1917. Three days later the S.E. was damaged in combat and repaired by No. 56 Sqn. personnel, but in another two days it was so badly damaged by anti-aircraft fire that it had to be despatched to an aircraft repair depot. However, Ball was then of sufficient standing to request that it be urgently repaired and returned to the squadron. In fact it was delivered next day. On May 7, 1917, Ball fell in A4850 and the exact manner of his death seemed likely to remain a mystery of the war; but new evidence by witnesses, both on the ground and in the air, may settle this point once and for all. I only hope I can prevail upon the chief investigator to publish his findings.

A little-known Imperial War Museum photograph of Ball appeared in the recent *Air Aces of the 1914-18 War* [and is reproduced here]. It shows Ball (extreme right) being helped away from a Bristol Scout "C" which he had "pranged" at Orfordness.

London, S.E.4. BRUCE ROBERTSON.

In Search of Safety

I THINK Lord Brabazon's S.B.A.C. dinner speech about the future of the British aircraft industry was well timed, and rich with sound advice. It is not everyone who wants to travel at 5,000 m.p.h., for there are many, in view of this black year of air accidents, who are more concerned with, to quote the late C. G. Grey, "machines that will fly dead slow under full control and will not burn up in the event of a crash." This should be the period of all-out investigation and financial backing for building further VTOL, STOL helicopters and Rotodynes, regardless of size, and of British manufacture. Our greatest hope is the Fairey Rotodyne, but I should like to see other British firms concerned with flying safety.

Birmingham, 14. MAURICE AUSTIN.

First Air Booking Office

YOUR contributor B. van der Klaauw claims in "The Flying Dutchman is Forty" (October 2 issue) that in 1921 K.L.M. opened the first air booking office in the world, in Amsterdam. But Lepaerial Transport had an air booking office in Piccadilly Circus early in 1920, presided over by Bob Loader.

And how could my old friend Albert Plesman have been on active service with the Dutch Air Force at Soesterburg in the Kaiser's war when Holland was neutral?

London, S.W.5. GEOFFREY DORMAN.

Light on Soviet Aviation

HAVING just received my copy of *Flight* for August 21 I really must congratulate you on the very excellent report describing the giant Tu-114 Rossiya. Quite apart from the obvious merit of this latest article on the newest generation of Russian-designed and built transport aircraft, in the past three or four years *Flight* has almost certainly published the most informative articles and reports on U.S.S.R. civil and military aviation, illustrated by excellently reproduced photographs.

With the aid of your journal, I have managed to build up an ever-increasingly informative file on Soviet aviation, and more especially on Aeroflot's astounding progress in the past years. Is this thanks to the so-called "Iron Curtain" getting easier to penetrate? If, for example, readers will compare the illustrations published with "Moscow's Main Airport" on page 514 of your issue dated October 17, 1952, with those of the past three to four years, they will see what I am driving at. At the same time, my remarks are no reflection on the excellence of John Stroud's drawing of the Vnukovo terminal building published so many years ago, when the "Iron Curtain" was 100 per cent in force.

Nairobi, Kenya. DENNIS M. POWELL.

The Avian Gyroplane

AS an old *Flight* contributor, I was most interested to read your August 28 editorial on autogyros and your reference to our work in this field on page 80 of the same issue. I should like to point out, however, that my association with the "flying saucer" project headed by John Frost ended some years ago, and that I was never a "senior test engineer."

Avian Industries Ltd. is staffed on the design side by the key members of a rotary-wing design team which was built up over the eighteen months previous to the Arrow cancellation at Avro Aircraft Ltd., and includes some well-known rotary-wing engineers from the United Kingdom. We have thus salvaged something from the wreck, but I should like to make it clear that we have absolutely no connection with Avro Aircraft.

In the six months of the company's operation we have designed the Avian 2/180, submitted all the drawings to our equivalent of A.R.B. together with completed stress analyses, manufactured (mostly in our own plant) 95 per cent of all the components and are now assembling the first two prototype aircraft. Since we have made very few concessions to the design of the prototypes, most of the assemblies being designed for quantity production, we feel confident that when the aircraft flies we shall have established something of a record in the industry, and that the only other projects that can approach this time-scale are those which employ a substantial number of components from an existing design, or that are purely prototype "lash-ups."

Georgetown, Ont. P. R. PAYNE,
President, Avian Industries Ltd.

CORRESPONDENCE . . .

Neighbours at Variance

IT is pleasing to read that Mr. P. Q. Reiss (September 18) has received such courteous treatment from the airport manager and staff at Croydon. It is, however, regrettable that such kindly attention was not extended to the airport manager's neighbours. As a moral to other aerodrome operators in how not to treat their neighbours and arouse their enmity, may I tell a little tale?

A few years ago a Dakota, coming in to land, knocked the chimneys off my house. I immediately wrote to the airport manager. Not even an acknowledgment of my complaint, nor a visit, were received. I did not receive any satisfaction until my M.P. took up the matter with Ministry Headquarters. Even then there was no apology for the distress caused by this low flying.

This indifference to the well-being of the local residents aroused my wrath and ever since then one of my hobbies has been investigating the amount of public money paid out to private airline operators and flying clubs in the form of hidden subsidies to keep open uneconomic aerodromes. I have been one of the strongest opponents to the move to keep Croydon open, and have dug up every argument against such a capitulation by the Ministry to the aerodrome tenants.

Perhaps the publication of this short note may bring home to other aerodrome operators the need to show as much courtesy to their neighbours as they show to their customers.

Croydon, Surrey. A LONG-SUFFERING LOCAL RESIDENT.

No. 16 Sqn.: Information Wanted

THE history of No. 16 Squadron is one of a number of R.A.F. squadron histories I have selected for a book I am working on, and amongst the notes I have prepared are one or two interesting items which call for more detailed information and personal knowledge. It would be appreciated, therefore, if I could appeal to any old members of "Sixteen" who may be able to supply additional information. (My address is 5 St. Hilda Street, Bridlington, East Yorkshire.)

Throughout the heavy fighting in France in 1940 No. 16 lost a third of their strength in an effort to complete the tasks set them. At one stage in the battle a S/L. Skelton repeatedly flew over the lines in a Tiger Moth to complete some successful shoots for the artillery. Can anyone give more details about this gallant officer and the actions he carried out? Also, on what date in June 1941 was W/C. Hancock killed, and who was the air gunner in S/L. Walker's Lysander when they were shot down by Me109s over Exmouth?

During the last six months of 1944 the squadron experienced a casualty turn-over of 75 per cent. Information on events covering this period would be appreciated.

For the same reason as above:—

No. 44 Squadron: Can any reader who served with this unit in its early days, 1917-1919, recall events as they happened?

No. 158 Squadron: Was its number really used at any time in 1918? Nucleus assembled at Driffield in May 1942, and moved under W/C. Robinson to Eastmoor in June 1942, then on to Rufforth towards the end of the year. Additional information on its early "ops" would be of interest, and also on the unfortunate incidents which resulted in "Q for Queenie" being scrubbed off the nominal roll for a short time.

Bridlington, Yorks. J. L. DIXON.

Basic Cooling

AFTER noting your picture and caption about the "Coolon" ventilated cushion (page 56, August 21 issue) I cannot help but make a comment.

While a member of the 58th Air Rescue Squadron, at Wheelus Field, Tripoli, Libya, I had the honour of working with the R.A.F. Tropical Experimental Unit, Idris. The unit was operating a Westland S-55 under tropical conditions. I became close friends with Lt-Cdr. Harry Phillips, Mr. J. W. Leach (Senior Trials Officer), and the Westland technical representative (name unknown).

I flew with Cdr. Phillips in an Air Force H-19 so he could check out the Sikorsky auxiliary servo system. In his final report on this flight, Cdr. Phillips gave a great deal of praise to the American-made version of the "Coolon." I believe he stated that it was the first time he had returned from a flight with a dry flying suit. This flight took place in August 1956. I started using one of these seats while going through helicopter pilot training and it was not long before everyone was using them.

Having been stationed in Texas, Libya and now Alabama, I am a true believer in these cool seats, and I am sure Cdr. Phillips agrees with me. I just thought you might be interested in the above information.

Mobile, Ala. (LT.) JOHN M. SLATTERY
(a loyal follower of *Flight*).

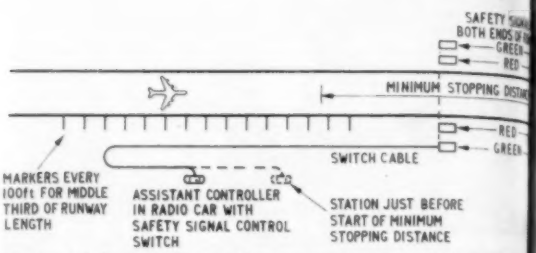

SAFETY SIGNALS AT BOTH ENDS OF RUNWAY
GREEN
RED
MINIMUM STOPPING DISTANCE
RED
GREEN
SWITCH CABLE
MARKERS EVERY 100ft FOR MIDDLE THIRD OF RUNWAY LENGTH
ASSISTANT CONTROLLER IN RADIO CAR WITH SAFETY SIGNAL CONTROL SWITCH
STATION JUST BEFORE START OF MINIMUM STOPPING DISTANCE

Diagram of the take-off control system suggested by Mr. H. L. Warner

Take-off Monitors

REFERRING to the article on "Take-off Monitors" in *Flight* for September 25, the host of variables and complications appears to give indefinite results for the monitor system, and cases of insufficient lift due to icing or overloading do not seem to be covered.

A safe take-off depends simply on having sufficient lift after a certain distance travelled (speed and acceleration being complementary factors only) so, by approaching the problem from a practical viewpoint, I was able to submit the following safety scheme to the M.o.S. shortly after the Munich crash, in an effort to provide a suitable safeguard against insufficient lift.

Road and rail traffic is controlled effectively by safety signals, so why not a similar scheme, as shown in the enclosed sketch, for the safe take-off of aircraft—especially for flights planned near the limit of a runway's length, or in icing conditions?

The signals need to be green and red only, preferably duplicated near each end of the runway for take-off in either direction. Switching from green to red would occur only in the event of an aircraft failing to become airborne by the time it reached the starting position of its minimum stopping distance from the end of the runway—with suitable allowances for time-lag and gradient.

This scheme would relax take-off tension in marginal conditions and relieve the pilot of any embarrassment in connection with a decision to abandon take-off.

The sketch shows the most simple of the signal schemes, with the switch operated by an assistant airfield controller, observing the take-off from a car stationed at the critical position for any particular aircraft about to take off. The signal controller could, if necessary, have radio or telephone contact with the duty airfield controller.

This scheme could no doubt be developed to provide automatic switching of the signals if required, but simplicity and reliability should remain. In the interest of safety in air travel, criticism by experienced transport pilots of this suggestion as compared with the monitor system would be most welcome.

Weybridge, Surrey. H. L. WARNER.

IN BRIEF

F/L. A. I. Alder is compiling a comprehensive history of No. [illegible] Sqn. and would be grateful to hear from ex-members (or former members of No. 7 Sqn., R.N.A.S.) with relevant information or photographs. Though any material will be welcome, F/L. Alder is primarily interested in the No. 7 Sqn. and 1918-39 periods, because of the paucity of official information available. The squadron is based at R.A.F. Marham, King's Lynn, Norfolk.

FORTHCOMING EVENTS

Oct. 27. R.Ae.S.: "Aircraft Fatigue," by R. J. Atkinson.
Oct. 27. Radar and Electronics Association: "Electronics in Supersonic Flight," by F. W. Page.
Oct. 28. Brit.I.R.E. (Radar Group): "An Historical Survey of Radar and Radio Aids to Aircraft Navigation," by Air Marshal Sir Raymund G. Hart.
Oct. 28. R.Ae.S. Graduates' and Students' Section: "Setting of Aircraft Specifications," by R. H. Whitby.
Oct. 29. R.Ae.S.: Special General Meeting, the Society and the Helicopter Association.
Oct. 30. R.Ae.S.: "Man-powered Aircraft, Theory and Practice," by H. B. Irving, Dr. D. R. Wilkie, T. R. F. Nonweiler and B. S. Shenstone.
Oct. 30. Surrey and Kent Flying Club: Annual Dinner Dance.
Nov. 2. Brit.I.R.E. (Liverpool Branch): "Electronics in the Autopilot of Firestreak," by A. Bedford.
Nov. 3. R.Ae.S. Astronautics and Guided Flight Section: "Control Mechanisms," by Dr. F. Errington.
Nov. 3-6. Institute of Welding: Autumn Meeting.
Nov. 4. Air Britain: Photographic Contest, Caxton Hall, London, S.W.1.
Nov. 4-11. Kronfeld Club: Painting Competition.
Nov. 6. Helicopter Association: "Application of the Jet Flap to Rotor Control," by R. Dorand.

R.Ae.S. Branch Fixtures (to Oct. 30): Oct. 27, *Luton*, debate; Oct. 28, *Weybridge*, "Kinetic Heating of Aircraft Structures," by A. W. Kitchenside.

Rolled out on the tarmac at Canadair's Montreal factory is the first CL-44. This first aircraft is the side-loading version ordered by the R.C.A.F., and it should fly next month

AIR COMMERCE

ELAND-CONVAIR OPERATIONS

THREE successful months of local-service operations with the Eland-powered Convair 540 leased from Napier Inc. have encouraged Allegheny to request an extension of their lease. The aircraft has been operating daily, with one break, over Allegheny's routes since July 1; but before deciding to operate a Convair 540 fleet, the airline want until December 31 to complete a further evaluation.

The break in service occurred in July when the aircraft was withdrawn for engine changes; transport of Eland engines by road had resulted in some Brinelling of bearings, and altogether three replacement engines were required. Napier have since designed a new transport rig and the trouble has been overcome.

The Convair 540 was operated in August over an average stage length of 199.8 st. m. (Allegheny's overall average is 84.7 st. m.) and in July and August it flew 80,924 miles. This represents a utilization of 6 hr 10 min per day, in comparison with utilizations of 5 hr 7 min for the airline's Martin 2-0-2s and 5 hr 16 min for its DC-3s. Scheduled miles flown per hour were 262.5, against 176.5 for the Martins and 138.1 for the DC-3s; but this figure must be judged against the longer-than-average stages on which the turboprop was used.

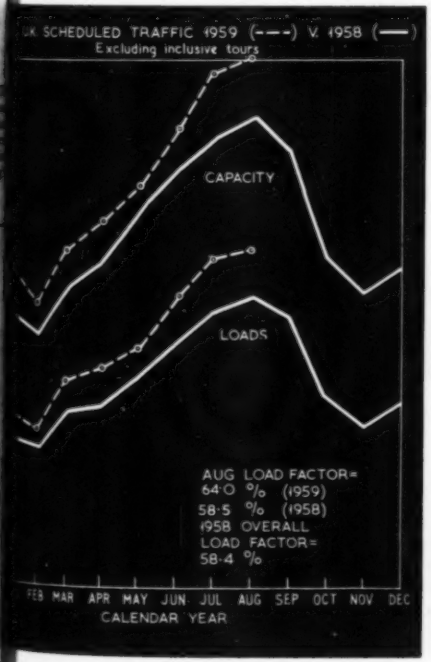
Comparisons in terms of revenue show that the Convair in 44-seat configuration earned more per revenue mile than the other two types in the fleet; the results were: Convair, $1.92; DC-3, $1.27 and Martin $1.77. Direct operating expenses were a little higher than for the Martin (97.47 cents per revenue mile compared with 93.45 cents) but because revenue was higher the profit ratio was greater, although some way below that of the DC-3. However, depreciation costs on a new, and not a converted Convair, were used in calculating direct costs, and the aircraft was insured for $1m. A depreciation cost calculation based on a converted aircraft would give a d.o.c. of 85 cents per revenue mile.

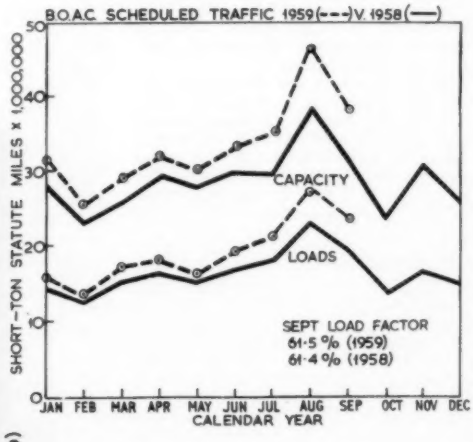
Although Allegheny's first reports seem favourable, Napier are still faced with competition since the airline is evaluating in parallel the Allison-powered Convair conversion.

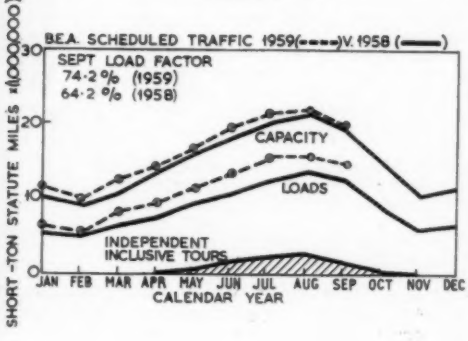
HOW GROWS IT?

THE British airlines are now over their annual summer peak and these graphs, which have been prepared by *Flight* largely from M.T.C.A. statistics, show that 1959 has so far been a year in which British air transport has expanded healthily and, thanks to well-judged scheduling after a depressing 1958, managed to attain good load-factors.

These "Flight" graphs illustrate the way in which U.K. air transport has progressed in 1959 compared with 1958. As discussed in the accompanying text, results have been good







Looking first at United Kingdom air transport as a whole, load ton-miles of traffic carried in the first eight months of 1959 were a sound 16.0 per cent up on the corresponding period last year. The all-important index of financial prosperity, load factor, was 60.5 per cent compared with 58.3 per cent in the first eight months of last year—2.2 percentage points up. B.E.A.'s results in particular have been most encouraging. Their traffic in the first nine months of 1959 was nearly 20 per cent up on the same period last year, and load factor was a remarkable 68 per cent—a gain of 8 percentage points on last year.

B.O.A.C.'s performance has been good, if not so spectacular in terms of load factor. Traffic carried during the first nine months of 1959 was 14.1 per cent up on the same period last year, whilst load factor (underestimated in the last edition of "How Grows It") was a satisfactory 57.4 per cent compared with 57.6 per cent last year.

AIR COMMERCE . . .

I.A.T.A.'s Open-fare Crisis

B.O.A.C. DECLINES TO YIELD : B.E.A. COMPROMISES

By J. M. RAMSDEN

THE essence of the annual I.A.T.A. battle over air fares, as everyone knows, is compromise. An airline which goes to a traffic conference with its mind made up on a particular issue, as B.O.A.C. did at Honolulu, is likely to lose a lot of friends, and to foul the delicate machinery which international air transport has devised to ensure its own smooth running.

British European Airways wanted, as discussed later, what B.O.A.C. wanted: economy-class service. But they were prepared to compromise, and they said so in public before the meeting. B.O.A.C., however, publicly stated several times that they were not prepared to compromise. They wanted economy-class service on their southern and eastern routes, and if they did not get them the Government would "review the fare structure on British cabotage routes."

This was undoubtedly the reason for the breakdown of the Honolulu conference, which ended in deadlock. It was not the first time that a traffic conference had failed to reach complete agreement on everything, but it was the first time that there had been such a very wide measure of disagreement. The B.O.A.C. delegates were prepared to negotiate, but they were not prepared to compromise on basic economy-class issues.

I.A.T.A. ordains that the deliberations of its traffic conferences shall be completely secret. It is thus difficult to know precisely what transpired at Honolulu. However, it is believed that the following reviews accurately the progress of the battle. It is based largely on the address of Mr. W. Gordon Wood of T.C.A. (who was chairman of the Honolulu conference) to the I.A.T.A. general meeting at Tokyo earlier this month.

On the first day of the Honolulu meeting all the airlines except B.O.A.C. agreed on a two-class fare structure world-wide. At a pre-conference meeting in New York in July, B.O.A.C. had made known their requirement for three classes of service on the North Atlantic. Discussions began on the basis of a two-tier structure, but B.O.A.C. could not change their position.

It seemed that the key to agreement lay in the fares between Europe and the Far East and Australia. Of the carriers operating between these areas, three (B.O.A.C., Qantas and Pan American) wanted to introduce economy fares as from April 1, 1960, at various percentages below existing tourist levels. At the same time, these carriers wanted to increase first-class fares.

Other carriers thought that the time was not yet ripe for the lower fares, though all except one were ready to consider smaller local decreases. B.O.A.C. were not alone in refusing to accept any of these compromise proposals; it is believed that they were backed by Qantas, Pan American and T.W.A. At one point B.O.A.C. were prepared to compromise if economy fares between Europe and Africa could be agreed, at a level 20 per cent below tourist fares. Here again B.O.A.C. were supported, in this case by S.A.A., E.A.A.C., and C.A.A.

African Compromise Proposal

One compromise proposal for the African routes was that promotional fares should be introduced until the end of 1960; that economy fares should be introduced as from January 1, 1961; and that the exact figures should be fixed at the autumn 1960 traffic conference, and that they should not be higher than the figures shown by I.A.T.A.'s cost committee to be necessary to break-even in 707s and DC-8s fitted with six-abreast, 34in pitch seats at a 65 per cent load factor. Other carriers opposed this, but repeated that promotional fares might be a good interim compromise. This was not, however, acceptable to B.O.A.C., who were set on the immediate introduction of economy class.

Many airlines felt that it was unfair of B.O.A.C. to bargain agreement in Africa for a compromise on the Eastern routes—particularly as many carriers did not operate in both areas. To predicate a settlement in one large area upon agreement in a totally different area was felt to be something that could lead I.A.T.A. into great difficulty in the future.

So far as the jet *v.* turboprop differential was concerned, there seemed to be agreement that the problem could be settled on the eastern routes by granting the older aircraft rights to have high-density seating. However, this proposal was not acceptable when fares between Europe and the Middle East were discussed. On these routes no less than ten airlines initially insisted on a jet surcharge, and all agreement on fares between Europe and the Middle East foundered on this rock. On the North Atlantic route opinions seemed to have moved away from the jet surcharge idea, but it is interesting that five carriers insisted on a propeller discount on this route. On the South Atlantic two carriers required a jet surcharge, but eventually yielded; fares between North and South America were finally agreed with a small jet surcharge related to first-class one-way fares. On these routes there was full agreement at Honolulu.

When it became apparent that fares between Europe and the Far East and Europe and Africa could not be agreed, it was proposed that, in order to avoid the dreaded open rate situation, the airlines should consider maintaining the *status quo*, subject to the revision of jet seating configurations and the adoption of easily agreed fare revisions. There were objections from seven of the 50-odd airlines who voted on this proposal.

One proposal on the question of jet seating was that 42in pitch should be adopted for first-class services, with 54in pitch in the Comet 4 producing an equivalent standard of comfort to the 707 and DC-8. A compromise proposal that 47in pitch should be granted to the Comet 4 was not accepted. The matter of 34in pitch for the tourist-class service was another vexed question which did not yield to unanimous agreement, and as a result no standard was decided.

Many airlines at Honolulu felt that B.O.A.C. might have given ground on the *date* for the introduction of the economy-class service, bearing in mind that I.A.T.A. took two years to agree North Atlantic economy-fares. During the third week of the meeting the points of view were so irreconcilable that further discussion appeared to be pointless. When the conference began on September 22, delegates were told that under no circumstances would the conference extend beyond October 10. In other words they were told to agree—or else.

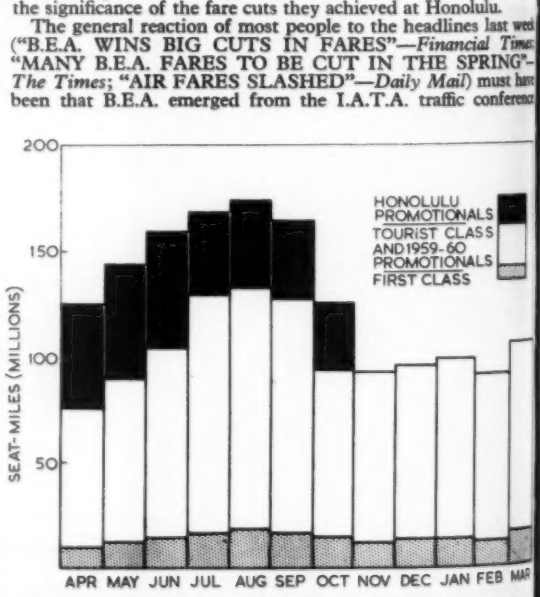
There will be no further traffic conference until September 1961, and for the first time in its history I.A.T.A. appears to have accepted the possibility of an open rate situation. And it is a British airline which—in the opinion of the majority of the world's airlines—is responsible.

B.O.A.C. and the new Ministry which, under Mr. Duncan Sandys, is responsible must now weigh the advantages of going it alone very carefully against the desirability of law and order in international air transport.

B.E.A.'s Compromise

What of B.E.A.? It is difficult for an outside observer to penetrate the curtain of secrecy which surrounds the circumstances of their "compromise victory," but the following is an assessment of the significance of the fare cuts they achieved at Honolulu.

The general reaction of most people to the headlines last week ("B.E.A. WINS BIG CUTS IN FARES"—*Financial Times*; "MANY B.E.A. FARES TO BE CUT IN THE SPRING"—*The Times*; "AIR FARES SLASHED"—*Daily Mail*) must have been that B.E.A. emerged from the I.A.T.A. traffic conference



Perspective 1: Prepared with the help of B.E.A., this "Flight" chart shows that about a third of the seat-miles which the Corporation plans to offer for sale in 1960-61 will be at the new off-peak cut rates agreed at Honolulu, as discussed in this article

at Honolulu with the go-ahead for sweeping price cuts everywhere.

It would be wrong to belittle the importance of the fare cuts won by B.E.A. at Honolulu as far as the holiday market is concerned. But it would be equally wrong to regard the cuts as wholesale reductions everywhere, or indeed throughout the holiday season.

Whilst B.E.A. have gone further than B.O.A.C. in achieving their ultimate objective, namely, the universal introduction of economy class service, they have still a long way to go, as the chart shows. Moreover, the B.E.A. objective (unlike B.O.A.C.'s) is to avoid a three-class fare structure, i.e., for economy class completely to replace the existing tourist class.

If they had been able to achieve the introduction of economy class in Europe, B.E.A. would have been able to sell something like 90 per cent of their summer international seats at economy fares. This would have meant a reduction in fares everywhere, and even larger reductions on holiday routes. But, as the chart (p. 444) shows, the Honolulu fare reductions are likely to be applied instead only to about 20 per cent of B.E.A.'s 1960/61 seat-mile offering. No details have yet been released about winter fare cuts, but it is unlikely that there will be many.

It is worth recapitulating the recent history of B.E.A.'s fares policies. In their 1956/57 annual report, published soon after the I.A.T.A. airlines agreed to introduce economy class across the North Atlantic in summer 1958, B.E.A. said:—

"B.E.A. is seeking the agreement of other European operators to a policy which will take advantage of the economies which may be achieved [by increased seating and simpler service] and will pass on these economies to the travelling public in the form of cheaper fares. The overall fare reduction which might be possible would not, however, be large—particularly when account is taken of present slender operating margins and constantly increasing price levels—but greater reductions may be possible on routes of high traffic potential."

Some eleven months ago [Select Committee Report, November 13, 1958] B.E.A. were hoping and planning on the basis of economy class—reduced catering and high seating capacities—to be able to reduce fares generally. They were also planning to offer greater-than-average reductions on the routes of high traffic potential—the holiday routes. The Corporation's reasons for approaching the Honolulu fares conference with compromise plans, which postponed the general introduction of economy-class, have already been reviewed (September 4, page 104, September 25, page 307). Now that the promotional fares will be added to B.E.A.'s tariff (and of course to those of its pool partners with whom the Honolulu proposals were all thrashed out beforehand) it is possible to consider their importance to B.E.A.

In 1960/61 B.E.A. will have available something like 30 per cent more capacity than in the current year, 1959/60. New fleets of Comet 4Bs and Vanguards, each worth three or four Viscounts in terms of work capacity, must be filled. In addition, the seating capacities of the existing Viscount fleets are being substantially increased, the 25 V.701s (mostly domestic) from 47 to 63, the 21 V.802s from 57 to 66. On routes where bilateral agreement to avoid catering can be obtained, the 802 will have 70 seats. It is worth noting that B.E.A. went ahead unilaterally with the installation of high-density, light-weight seating in its Viscounts, regardless of international agreements, *pour encourager les autres*. It appears that this part of the economy measures has worked, and that no objections have been raised by B.E.A.'s pool partners. But it has not proved possible—except it is believed on the Paris route—completely to eliminate or even to reduce catering. There is no I.A.T.A. rule against the bilateral elimination of catering, and B.E.A. will no doubt continue to press its European partners to cut out this particular frill on other routes, because it is in this field that there lies room for further major economies.

The "Honolulu holiday fares" are, as expected, all off-peak discounts on holiday routes, and not all the holiday routes are included. Like the present mid-week and night-tourist discounts they are designed to maximize aircraft utilization. Being holiday route discounts they will not diminish B.E.A.'s overall summer-winter peak/trough ratio—at present about 2:1. Indeed, they may aggravate this ratio; but more important to B.E.A. is the fact they will spread the peak over a longer period, and will smooth out some of the summer "peaks within peaks." The new fares will also have the effect of making B.E.A.'s summer longer, by "encouraging people to take their holidays earlier," as a B.E.A. spokesman put it. On certain routes reductions will be greater between April and mid-June, thus following the pattern already adopted with much success on the Corporation's ultra high-peak Channel Islands routes.

Only the general outline of the proposed reductions has been given by B.E.A. It appears there will be cheaper day fares throughout the week on routes to Spain, Italy, Portugal, France, U.S.S.R. and parts of Austria and Germany. However, these reductions throughout the week will only apply in April to mid-June. Cheaper night-tourist fares will follow the same pattern of reductions to Spain, Italy, France, Portugal and Greece. Only in relatively few cases, it is understood, will the fare reductions apply throughout the week *and* throughout the season.

It is said that the reductions will vary from between 15 and 25 per cent as from April 1, 1960. It is believed that these percentages are related to the existing discount fares, although this has not been made clear.

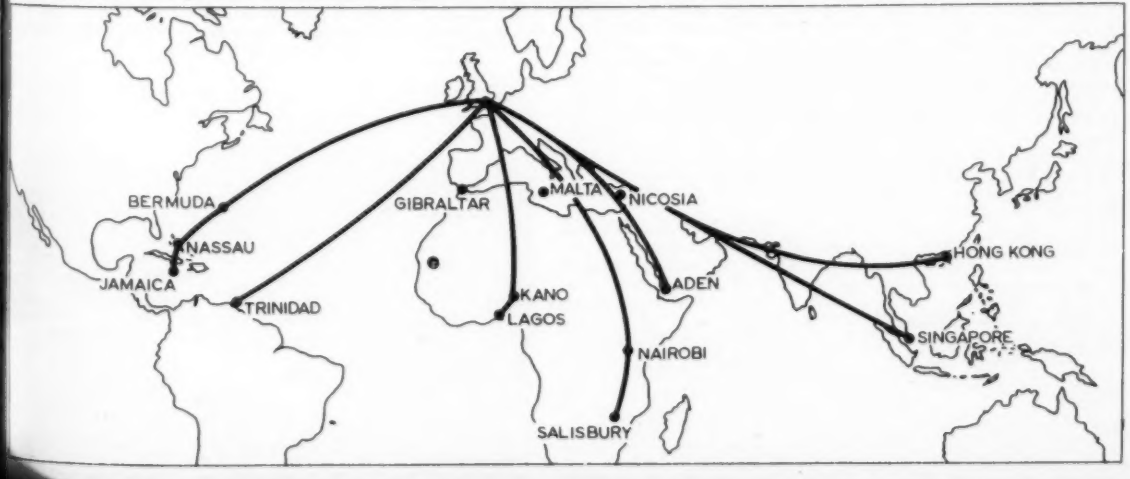
To sum up, B.E.A. appear to have reasoned as follows: "We wanted to introduce economy class service which would have permitted us to afford across-the-board reductions about 15-20 per cent below existing tourist levels. But it was clear from negotiations with our partners that this would have been fought tooth and nail in I.A.T.A. because it would have involved introduction of no-catering economy class. Other operators were not prepared to accept this. We might have got agreement on a 10 per cent across-the-board reduction, but this would not have increased traffic enough to cover the rate reduction. On many routes we would have just been giving 10 per cent away.

"Therefore we have sought agreement to extend the existing structure of off-peak mid-week and night discount fares, both by reducing these fares and by extending their availability throughout the week in the off-season period. In this way we shall get more traffic to fill our large planned capacity, we shall ease our costly peak problems, and we shall also be able to offer reduced fares to a larger proportion of the holiday public by unilaterally increasing the seating capacities of our aircraft."

B.E.A. have got their compromise, without causing offence to their partners, and as a result lower fares will next year be available to holidaymakers who are prepared to travel either in the early season or middle of the week in the peak. For the regular traveller on the non-holiday routes, and for the holidaymaker who prefers to travel at peak week-ends in July and August, the result of the Honolulu contest is "no change." As for B.O.A.C. on world-wide routes, the target for B.E.A. in Europe is still the introduction of economy class as a standard service.

Footnote: Both I.A.T.A. and B.O.A.C. issued prepared statements after the Honolulu conference. The I.A.T.A. statement said that "only partial agreement" had been reached, and that the airlines had never before been faced with problems of such complexity. The chairman of B.O.A.C., Sir Gerard d'Erlanger, expressed B.O.A.C.'s "extreme disappointment" at the failure to agree on the extension of economy class, and said that B.O.A.C. would now have to consult with the Government about fares on British cabotage routes.

Perspective 2: This "Flight" map shows the cabotage points between which Britain can, if it wishes, fix its own air fares. It has not done so in the past (with the exception of independent colonial coach fares) so as not to undermine the I.A.T.A. fare structure. The text on the opposite page poses the question: Will B.O.A.C. now go it alone on routes such as these? (N.B. Nigeria becomes non-cabotage next October)



AIR COMMERCE . . .

VISCOUNT FREIGHTERS FOR AER LINGUS

AER LINGUS are believed to be seriously considering the conversion of their four Viscount V.707s to freight carrying. The four aircraft have been offered for sale, apparently without success, and have been positioned at Dublin in "mothballs" awaiting a buyer for the last six months. Douglas DC-3s seem to find a readier market than Viscount V.700s (Aer Lingus have now sold eight of their 13 Dakotas) and, presumably, the fleet of five DC-3s used now as freighters would be disposed of comparatively easily. Aer Lingus might then qualify as the first airline to operate an all-turboprop freighter fleet.

NEWS FROM LEEDS/BRADFORD

B.K.S. AIR TRANSPORT have enjoyed a good season on their Leeds/Bradford - Dublin service, which opened on July 6, 1959. The thrice-weekly return flight has operated at extremely high load-factors during July, August and September, and certainly exceeded by a handsome margin the summer-season target of 2,000 seats. During the winter period, in addition to their thrice-weekly Dublin service, B.K.S. will operate their five-times weekly return Belfast service; and twice-weekly to Newcastle and to Dusseldorf (via Rotterdam), using DC-3s. North/South Airlines will operate a twice-weekly return service to Bristol, a thrice-weekly service to Exeter (via Bristol) and a once-weekly return service to the Channel Islands (via Exeter) with Herons.

Work on Leeds/Bradford Airport's approach and runway lighting has been authorized and tenders for the work advertised. The two city corporations plan to start work on a new terminal building before beginning construction of a third runway in the near future.

I.A.T.A. FAVOURS FINGERS

WHETHER or not lightplanes, business aircraft, helicopters and sightseers are encouraged, the main purpose of a major airport is to handle airline services safely and efficiently. So when I.A.T.A. issued the first edition of their guide to the planning of *Airport Buildings and Aprons* in July 1956 it was regarded as an invaluable indication of what the most important customers want.

At that time airline jet operating experience was limited to a period with the Comet 1; but I.A.T.A.'s technical experts did some crystal-gazing and there was published in January 1958 a follow-up document entitled *Apron Requirements for Turbine-powered Aircraft*. These original books have now been revised and are combined in a 179-page second edition of *Airport Buildings and Aprons*,* dated August 1959 and incorporating material based on the first nine months of big jet operations. It includes 22 charts, ten tables and a glossary of terms, newly given in English, French and Spanish.

I.A.T.A.'s fundamental aim is to get the kind of airport that will ensure the speediest possible turnround of its members' aircraft, but this is not allowed to obscure the economics of doing so. There are occasional hints of how nice it would be if individual operators had stands specially reserved for their aircraft, with fixed services piped in and movable overhead passenger gangways; but such thoughts are brushed aside as being impractical from two points of view—those of cost and of flexibility in apron movements.

Nevertheless, it becomes abundantly clear on reading this document that flexibility must soon be regarded as limited; I.A.T.A. recommendations are intended to apply only to international and combined international-domestic airports. This implies an inherent dislike of the free-for-all type of airport. It seems probable that eventually major airports will accept only airline traffic, as London Airport does already at peak periods, to the annoyance of private pilots, but with the utmost approval of the men whose job is to fly passengers safely in and out.

This particular document is concerned only with what happens on the ground; but even here it is clear that a Piper Cub exposed to the blast from a taxying 707 might never be the same again. In any case, sheer economics preclude single-engined machines from occupying a stand at a major airport, and *Airport Buildings and Aprons* lends weight to the belief that, to ensure real efficiency in the future, terminals like London Airport might have to be devoted exclusively to international turbine-engined traffic of, say, Viscount size or more.

An exception, to which a section of the book is devoted, will be large transport helicopters used to carry passengers between city centre and airport. Guidance is given on how such aircraft could and should be accommodated and their payloads processed, from which it becomes apparent that they would best be treated as normal transport aircraft on the ground. In particular, roof-top landing sites are ruled out on the score of cost and the difficulties of making them large enough or of providing services such as refuelling facilities high above the apron.

One difficulty which may not have been generally appreciated is that "An object lying on the ground might well become airborne as a result of the vacuum effect caused by a helicopter taking off, and such an object could be ingested into the engine intake of a turbojet aircraft in the vicinity." An even bigger problem—the integration of helicopter arrivals and departures with the movements of fixed-wing aircraft—is said to be outside the scope of this book.

In detail, I.A.T.A. favours finger or pier terminals, despite criticisms which have persuaded the architects of Dulles International Airport, Washington, to switch to "mobile lounges" on an open apron. I.A.T.A. put forward strong objections to open aprons and indicate that except on the score of cost their No. 2 choice might be for island satellites to which access was given by tunnels.

The basic factor in favour of fingers is that "The airlines consider it essential that aircraft should be permitted to manœuvre on the apron under their own power." They list all the difficulties of towing the big jets and state that "The installation of conveyance systems (for moving the complete aircraft) at an airport is considered impractical," while "operators' experience has not given any indication that auxiliary wheel-drive devices are unsatisfactory."

Fingers thus become almost essential and two-floor fingers, as envisaged for London's new long-haul building, are particularly good. The lower floor, most exposed to noise and blast, can be devoted to workshops and storage for vehicles and equipment that need a measure of protection. Passengers can then be channelled along the upper floor, which ideally should be sealed off on the air-side, even to the exclusion of windows. Another strong recommendation is for passenger flow arrangements to be such as "to permit individual processing or trickle-loading."

Fixed aircraft services are seen as essential to relieve apron congestion once the optimum layout has been determined and I.A.T.A. anticipate that fixed refuelling installations will be required at airports at which large quantities of fuel must be supplied rapidly. But the optimum layout cannot be decided until the layout of the airport buildings has been irrevocably determined, because the cost of laying down and then tearing up a hydrant system would be enormous—that is why the oil companies are producing 10,000-12,000 Imp. gal super-fueller vehicles when a hydrant system would be preferred.

There is much more of interest in this publication to help airport planners and re-planners. A nose-out parking position at an angle of 45-56 deg according to aircraft type, is recommended for stands; it is agreed that there is no objection to embarking or disembarking passengers while refuelling operations are being carried out; a distance of 1,000ft is laid down as the maximum distance passengers can reasonably be asked to walk from the base of a finger to the aircraft, and powerful arguments are made against reversible or parallel channels as found in London Airport Central.

The whole adds up to an immensely thought-provoking document. There are one or two questionable comments. For example, it seems hard to expect passengers to carry their own baggage on future helicopter services which will, after all, bring to the terminal people bound for lengthy stays overseas. But above all it induces new respect and sympathy for airport planners of today, who have to provide even for such strange payloads as human remains and radio-active isotopes.

* *Obtainable from the I.A.T.A. Technical Secretariat, Terminal Centre Building, 1060, University Street, Montreal 3, P.Q., Canada. $2.00 (U.S.)*

At times working around the clock, 300 Fijians and Indians completed a 3,700ft extension to the main runway at Nandi, Fiji, in 11 months and in time for Qantas Boeing 707 services. Contractors to the New Zealand Ministry of Works were Taylor Woodrow (Overseas) Ltd., and the firm of D. B. Waite

SWISSAIR'S DAUGHTER

DURING Great Britain's Swiss fortnight Balair A.G., Switzerland's only air charter company, took the opportunity on October 13 of demonstrating one of their two DC-4s (HB-ILA) at Gatwick, where the aircraft was smartly handled by Transair. The Swiss airline had been engaged on a series of charters which had brought to England Swiss football teams which have been challenging British sides.

Balair (the word is derived from the airline's headquarters in Basle) is an old name in Swiss aviation circles, but the company has only become established as an operator within the past three years. Last year two ex-B.E.A. Vikings were purchased and the two DC-4s were acquired from Swissair in April and May of this year. The remainder of the fleet consists of 12 smaller aircraft which Balair use for training up to 200 pilots every year.

Balair describe themselves as the charter company "with the big interest in cabin service" and the interior of their DC-4—in fresh grey trimmed with red, and with candy-striped pillows and plaid rugs for the passengers—bears out their claim. The DC-4s are equipped with 72 reclining seats in threes and twos, or in an alternative 56-seat version. There are emergency oxygen points at each seat station. Swissair's catering service is used and the flag carrier's interest in the charter concern is such that Balair refer to themselves as "Swissair's daughter." In fact, 40 per cent of their shares are held by Swissair, who contribute three of the nine directors on the Balair board. Of the remaining shares 25 per cent are held by the Government and 35 per cent are privately subscribed.

Nearly all of the 150 employees are ex-Swissair, including the joint managing directors, Herr Otto Gersbach and Capt. Herzog (the latter is in charge of operations) and the chief pilot, Capt. Perry Wagner. Maintenance is, however, performed independently of the flag carrier, and about one-third of the staff are engaged on technical services. The particular aircraft demonstrated had been overhauled at 8,500 hr by S.A.S.

Since the DC-4s joined the fleet they have been kept busy with charters within Europe but some long-haul flights to Buenos Aires, Montevideo, New York, Bombay and Johannesburg are contributing to a probable first-year utilization of about 2,000 hr. No scheduled services are at present operated although the necessary authorization has been obtained.

Balair are examining the prospects of a replacement for their Vikings. What they want, they say, is a replacement as universally accepted as the DC-3. Their average fare is about half I.A.T.A. rate and it seems very important to them that any aircraft they operate should have a supply of spares available almost anywhere in the world. Thus brand-new equipment is not particularly attractive; they may buy DC-6Bs. Viscounts are another possibility, but they are doubtful if they could manage to achieve a profitable minimum of 2,000 hr a year on short-haul operations.

During the demonstration at Gatwick Balair emphasized that they could offer cheap fares on charter flights to winter sports resorts. Their agents in Great Britain are Lambert Brothers Limited, Cunard House, 88, Leadenhall Street, London, E.C.3.

CONVAIR 880Ms - AND ELECTRAS - FOR CAPITAL

ON successive days last week General David H. Baker, president and chief executive officer of Capital Airlines, was at last able to announce that firm orders had been placed for seven Convair 880Ms (M means modified) and five Lockheed Electras. The value of the Electra order is £4.5 million, and the aircraft will be delivered two in May and three in June next year.

The sum that the airline will pay for its 880Ms—delivery of which is expected in October, 1960, for service before the end of the year—is about £8.9m less spares. For comparison, when Capital first announced their intention of buying nine Convair 880s in January 1958, the price *with* spares was to be £1.4m for each aircraft. This earlier order was to have been made possible by General Dynamics (of which Convair is a division) helping to repay Capital's debts to Vickers and Rolls-Royce, which then stood at £17.3 million. This order never became firm.

In postponing repayment of notes due in 1958 and 1959, the chattel mortgage on Capital's Viscount fleet, by which the airline secured these notes, was amended to prevent the purchase or leasing of new equipment without the approval of the note holders. Announcement of the present orders must indicate that this approval has now been given. The "M" version of the Convair 880 "has been specially tailored to meet the requirements of short trip, fast turn-round operations." Modifications include leading edge slats, a larger fin with power-boosted rudder, higher landing weights and provision for pre-loaded baggage and cargo bins; otherwise it is generally similar to the Convair 880 Model 22. Gross weight is 191,000 lb. Power units will be General Electric CJ-805-3Bs, a modified version claimed to give "4 per cent more thrust for 2 per cent less fuel." They will be equipped with sound suppressors and thrust reverse.

Convair 880 and 600 orders now stand at 85 and Electra orders at 178.

BREVITIES

The first B.E.A. Vanguard services will be inaugurated on the London-Paris route on July 1, 1960, it is announced by the Corporation.

B.O.A.C. have started work at London Airport on the conversion of their four Constellation 749s bought for all-freight use by Skyways. The work will be spread over six months; it involves the fitting of a 6ft by 10ft door and heavier flooring.

Sud Aviation, General Electric and Republic are reported to be working together on a programme to offer G.E. CJ-805-23 turbofans in the Caravelle. It is possible that Caravelle No. 19 will be thus re-engined and tested next spring at Republic's Farmingdale base.

Varig and L.A.V. are proposing to obtain government approval for joint operation of Varig's two 707s. The proposal is that L.A.V. will operate flights between Caracas and New York with Venezuelan crews, in between Varig flights with Brazilian crews between Rio de Janeiro and New York.

As from November 1, B.E.A. are to restore their £8 winter week-end return fares on the domestic trunk routes to Edinburgh, Glasgow and Belfast. This is a rate equivalent to 2¼d a mile which, says Mr. Anthony Milward, should encourage seats "to sell like hot cakes, as before."

B.E.A. announce the appointment of Mr. J. F. Norton as assistant sales manager He was the Corporation's sales manager in North America, and he is succeeded in that post by Mr. H. R. Roberts. Meanwhile, Mr. R. Watts takes over from Mr. Roberts as manager, Sweden and Finland, and Mr. D. M. H. Russell becomes manager Malta and North Africa in succession to Mr. T. H. Pollock who has left the Corporation.

It is likely that Qantas will retrospectively fit its seven Boeing 707-120s (all of which have now been delivered) with Pratt and Whitney JT3D turbofans.

Mr. W. A. Patterson, president of United Air Lines, has defined his company's requirement for short-range jet airliners as "at least 55." He has also referred to the possibility of a United order for seven more Boeing 720s, to bring the fleet up to 25.

Lord Brabazon, chairman of the Air Registration Board, and Mr. R. E. Hardingham, chief executive, have had talks in America with the F.A.A. on the reciprocal acceptance of aircraft, engines and propellers and, in particular, of parts and accessories.

American Airlines are to modify the P. & W. JT3s of their Boeing 707s to increase take-off thrust from 13,000 lb to 13,500 lb. New stator blades ahead of the first stage of the turbine will increase heat tolerance, allowing jet pipe temperature limits to rise from 620 deg C to 630 deg C. The programme, costing nearly £100,000, will begin at Tulsa on November 1.

Since C.P.A.L. inaugurated transcontinental domestic services with Britannias on May 4, seat load factors west of Winnipeg have averaged 84 per cent and 95 per cent east of Winnipeg. The services, according to Mr. Grant McConachie, C.P.A.L.'s president, have made money. He announces that jet airliners will be put on the route "as soon as we can get them," which will probably not be for another year, though a decision between the DC-8 and the Boeing 707 would have to be made this month. Recently Mr. McConachie flew from Seattle to Tokyo on a B.O.A.C. 707-420 test flight. The national airline, T.C.A., will start transcontinental DC-8 services on April 1, and to the U.K. on June 1.

This winter Il-18s are to replace Aeroflot's Tu-104s on the London - Moscow service. Here is the first Russian turboprop to visit L.A.P., as seen by B.E.A.'s chief photographer on Thursday, October 15

SERVICE AVIATION

Royal Air Forces and Naval Flying News

Near East Visits

TWO squadrons of R.A.F. Fighter Command, Nos. 56 and 33, are making liaison visits to Turkey and Greece respectively this month. No. 56 Sqn., which is equipped with Hunters and has been on a reinforcement exercise in Cyprus, went to the Turkish Air Force station at Eskisehir on Monday of last week for a one-day visit; and No. 33 Sqn., which is equipped with Javelins and has also been on detachment in Cyprus, is going to the Royal Hellenic Air Force airfield at Larissa in Eastern Greece next Thursday for a three-day stay. These liaison visits are the first of their kind to have been made since the London agreement on Cyprus.

No. 33 Sqn. has historical associations with Greece, for its Hurricanes were based there from February to April 1941, their main task being to escort Blenheims on daylight raids. Though heavily outnumbered by the Luftwaffe, the squadron fought heroically and was among the last British units to be withdrawn from Greece.

Living Up to Its Name

FIVE pilots of No. 700G Intensive Flying Trials Flight of the Royal Navy completed 742 hr flying with their Fairey Gannet AEW.3s in 45 flying days during the Flight's first nine weeks' operations. The Flight (referred to on this page on October 2) was formally commissioned at R.N.A.S. Culdrose, Cornwall, on August 18 this year. Two production AEW.3s had been delivered to the station during the previous weekend so that flying could start at 8 a.m. on Monday, August 17. The unit was therefore fully operational three days before the first anniversary of the maiden flight of the prototype AEW.3 (on August 20 last year). The Flight, which is commanded by Lt-Cdr. W. Hawley, achieved 337 hr flying with only two aircraft in the first month of its existence. The third aircraft was delivered on September 15. The Mk 3 Gannet is to replace the Douglas Skyraiders at present used by the Royal Navy in the AEW rôle.

No Negative Compliment

PAST and present photographic officers from the three Services were entertained at Londonderry House on Wednesday last week. Their hosts were W. Vinten Ltd., whose managing director is Mr. Charles Vinten and who build (among other things) modern high-speed reconnaissance cameras. It was two of their 16 mm cine cameras which, fitted in the tails of two of Treble-One Squadron's Hunters, provided such exciting pictures for B.B.C. television coverage of the squadron's aerobatics at Farnborough.

Doyen of the party was W/C. L. Mant, who commanded a photographic section in the R.A.F. as far back as 1920. In a way the function was also a farewell party to the D.D. Ops. (Recce.) at Air Ministry, G/C. S. G. Wise, who has nearly finished his tour of duty and is expected shortly to be relieved by W/C. T. R. Peirce. His "opposite number" at Admiralty, Cdr. R. M. Crossley (Head of the Photographic Section, Directorate-General of Aircraft Equipment), was also among the guests.

R.A.A.F. Strength

DETAILS of present R.A.A.F. operational strength were given by Mr. Athol Townley, the Australian Minister for Defence, in a report on the three-year programme made recently. He said there were three fighter (Sabre) and three bomber (Canberra) squadrons, two M.R. squadrons (Lincolns and Neptunes), three transport squadrons (Dakotas, Metropolitans and Hercules), an A.O.P. flight and five Citizen Air Force fighter squadrons (Mustangs, Meteors and Vampires). Mr. Townley added that the R.A.A.F. fighter wing in Malaya is to be equipped with Sidewinder missiles "in the immediate future."

IN BRIEF

G/C. G. R. Magill is to be Director of Operations (Bomber and Reconnaissance) and G/C. L. C. Dennis Director of M.T., at Air Ministry from next month, each with the acting rank of air commodore. G/C. Magill until recently commanded R.A.F. Upwood and G/C. Dennis is at present Senior Equipment Officer at Transport Command headquarters.

* * *

R.C.A.F. pilots recently ferried to Turkey 22 T-33 Silver Stars, handed over as part of Canada's mutual aid to NATO allies.

* * *

Canberra B.2s of No. 5 Sqn., Royal Rhodesian Air Force, are undertaking a six weeks' training detachment at R.A.F. Akrotiri, Cyprus, with the Canberra wing of the Middle East Air Force.

* * *

F/L. Tony Powell, a flight commander with No. 77 Sqn. at R.A.A.F. Butterworth, recently won the Far East Air Force gunnery competition. Formerly in the R.A.F., when he was an instructor at the Fighter Weapons School, he is one of the few graduates of Cranwell to be serving with the R.A.A.F.

* * *

No. 56 Sqn., which recently returned to the U.K. from detachment in Cyprus, is holding a reunion dinner at Claridge's, W.1, on November 20. Full details may be obtained from F/L. C. C. Rustin, No. 56 Squadron, R.A.F. Wattisham, near Ipswich, Suffolk. A stamped addressed envelope should be sent.

* * *

The R.A.F. Benevolent Fund has received £65 from M.E.A.F. headquarters, following a donation from Air Charter Ltd. in gratitude for the help given by the Cyprus-based mountain rescue team which reached the wreck of the Super Trader which crashed earlier this year on Suphan Dag in Turkey. Part of the money has been devoted to buying a silver cup, to be known as the Suphan Trophy and competed for by units in M.E.A.F. for search and rescue work. The Cyprus-based team is to hold the cup for this year.

* * *

The fourth R.A.F. Anniversary Concert, at the Royal Festival Hall on April 14, raised £1,348 for the R.A.F. Benevolent Fund.

* * *

This year's Signals Command catering competition was won by R.A.F. Medmenham. Digby, last year's winners, were second and Haydock and Stanbridge third and fourth respectively.

* * *

F.E.A.F. headquarters have stated that the presentation to Sgt. Pat Cunningham (referred to on this page two weeks ago, following an Air Ministry announcement) was made by the Commander-in-Chief, Air Marshal the Earl of Bandon, and not by the C.A.S.-designate.

* * *

A reunion of F.A.A. and R.A.F. personnel stationed during the war at Pensacola U.S.N. air station, Florida, U.S.A., is being held on November 28 at the Feathers Hotel, Broadwick, London, S.W.1. Particulars may be obtained from L. V. Armstrong, 47 Rutland Road, Wanstead, E.11.

* * *

Whirlwind and Sycamore helicopters of the two R.A.F. search and rescue squadrons whose detachments are deployed around Britain—Nos. 22 and 228 (formerly 275) Sqns.—dealt with 241 rescue incidents between the beginning of this year and the official end of summer on September 21.

* * *

A reunion for former members of No. 6 Sqn. is being held at the Coronet Bar, Soho Street, London, W.1, on Saturday, November 7, with a running buffet from 6 p.m. onwards. Cost is £1 per head (including drinks) and the organizer is J. Swift, 17 Atkinson Street, New Cross, London, S.E.14.

High-level meetings in Copenhagen, Malaya and Australia: at left, King Frederik IX of Denmark shaking hands with Marshal of the R.A.F. Sir Dermot Boyle after His Majesty had been handed his commissioning parchment as an honorary air chief marshal by the British Ambassador, Sir Roderick Barclay (centre); below left, Air Chief Marshal the Earl of Bandon, Commander-in-Chief F.E.A.F., meeting the C.O. of No. 3 Sqn., W/C. C. Thomas (centre), and one of his Sabre pilots, F/L. S. Watson, during a visit to R.A.A.F. Butterworth recently; and below right, the Chief of the Air Staff, R.A.A.F., Air Marshal Sir Frederick Scherger (right) greeting Admiral Harry D. Felt, U.S.N. Commander-in-Chief Pacific, on his arrival at Canberra for talks with representatives of the Australian Government and Services